NATURE

Vol. 146 | SATURDAY, OCTOBER 5, 1940 | No. 3701

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Editorial and Publishing Offices :

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number : City 4211

Registered as a Newspaper at the General Post Office

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EVACUATION AND EDUCATIONAL POLICY

THE well-balanced report to the Fabian Society which has been edited by Richard Padley and Margaret Cole under the title "Evacuation Survey" is the most comprehensive of a number of admirable reviews of the situation which have already appeared.* Besides the investigations carried out by the Department of Social Science of the University of Liverpool and the articles in the *Quarterly Review* and the *Political Quarterly* which have already been commented on in these columns, there are Lady S. D. Simon's "The Children in War-Time" issued by the Workers' Educational Association and a further study "Evacuation : Failure or Reform" by F. Le Gros Clark and R. W. Toms, also issued by the Fabian Society.

The main impression which Mr. Padley and Mrs. Margaret Cole's report leaves is the lack of vision and co-ordination in the original planning. The absence of these was the prime cause of the confusion and difficulties which went far to wreck the original scheme and did the greatest mischief to the educational system. Until that position has been rectified it is idle to expect the firm action which is still required to bring order again into the field of education and prevent the perpetuation of damage to health and educational services alike.

On this point the criticism of the Government is sharp and severe. Confusion of thought appears to have characterized the conception of the scheme as well as its execution. Circulars issued by the Ministry of Health instructing the local authorities how to deal with evacuation problems convey the impression of a Government using the decentralized local government system, not as a means of making allowances for local needs and resources, but rather as a method of shirking its own responsibility. Difficulties are admitted with no long-term programme for their solution. Heavy burdens of organization are placed on small local authorities, ill-equipped for such detailed administration. Voluntary effort is continually relied on to provide services which the Government is unwilling to organize or finance.

Of the Departments concerned with administrating the scheme, the Board of Education, which alone showed sufficient imagination, was lacking in initiative, and allowed itself to be refused any major share of control. The Ministry of Home Security was obsessed with the prospect of destruction and too busy with other aspects of civil defence. The Ministry of Transport saw the whole thing purely as a technical problem ; and the Ministry of Health, which was responsible for the scheme, was far too timid to develop any serious policy. Over them all was the control of a parsimonious Treasury, which correctly interpreted the Government's attitude in resisting the expenditure which would have been necessary to assist the local authorities in offering proper services for the evacuees.

The survey does not suggest that any of the steps which the Government neglected would, in the absence of the heavy bombing which was expected, have made a complete success of the scheme. The shrewd and severe criticism, however, makes it very plain that with efficient planning and proper co-operation between the many local authorities and services the scheme would have come much nearer to achieving success. The Ministries at the centre failed to supply the wise and energetic guidance that was essential,

* Evacuation Survey : a Report to the Fabian Society. Edited by Richard Padley and Margaret Cole. Pp. viii+296. (London : George Routledge and Sons, Ltd., 1940.) 10s. 6d. net.

and it is well that we should remember that the considered judgment of the first evacuation scheme leads inescapably to the conclusion that the Civil Service, through lack of vision and constructive ability, missed an immense opportunity.

Sobering as are the reviews of the national scheme and the experiences of its working in different districts, or of the effects of the scheme on local administration or the various social services which are contributed to this volume, its main outlook and criticism are not retrospective or negative, but constructive. An opportunity was missed because, Mrs. Cole remarks, the scheme was unattractively drawn up "by minds that were military, male and middle class". They were not imaginatively alive to the real issues, human and social, underlying what was to them a mere matter of civil defence. The great value of this book is that it directs attention to the opportunities which are still before us and indicates some of the factors which require weighing and analysis.

The note of vision which characterizes the third part of the book in reviewing the outstanding problems of evacuation enables it to make a real contribution to those important aspects of education and juvenile and adolescent welfare which are with us as part of our war effort and as part of the social reconstruction which must proceed during, and not merely after, the War. The startling disparities between outlook and social habits and conditions which have been revealed to many for the first time by the evacuation have indeed to some extent loosened some of the former obstacles to reform. With a wide vision and a firm but sympathetic handling of these problems, much might yet be done to consolidate the solid gains in health which have in some districts already resulted, and to retrieve the mistakes which parsimony or sheer administrative incapacity have perpetrated. Success can only come when not merely the House of Commons but the whole country acquires a real interest in education and in the contribution to the national welfare which the school social services represent.

It is only possible to select a few of the possibilities for mention here. To take education in its narrowest sense in the first place, the outbreak of systematic bombing attacks with a main objective in the disintegration of civilian morale makes the provision of an education as complete as possible a matter of vital defence as well as a desirable end of statecraft.

It must be recognized that not all the dislocation of education has come from evacuation ; but there can be no question that the time has come when full educational facilities must be restored. Even if the whole time is not spent in a school, full-time education can and must be provided both in the reception and in the evacuation areas. Moreover, it is remarkable that the importance of bringing immediately into operation the Education Act of 1936, which raises the school-leaving age to the end of the term in which the child becomes fifteen, is now being urged not only by education authorities but also by other bodies of widely divergent interests.

The development and prosecution of an adequate education policy in this way involves naturally some reorganization and co-ordination. It will not be sufficient to hand over to the Board of Education all problems connected with the evacuation and billeting of children, including nursery school children, or to return immediately to the local education authorities all school buildings which are not absolutely indispensable for purposes connected with the War. Imagination and courage and real determination as well as administrative efficiency will be demanded of the Board of Education if it is to execute the required policy with success. No longer must the Board allow itself to be treated as a poor relation and overridden by other Departments.

The question of accommodation supplies an admirable instance in point. If the scheme at present operating is to succeed at all, it must have available not merely accommodation such as billeting premises but also adequate premises for teaching. A general survey of existing premises, which might well yield much of the accommodation required for all purposes, is urgent. Preliminary examination in some of the reception areas indicates that premises are certainly to hand which could frequently be used without drastic alteration. Wise and inspired improvisation could undoubtedly better the situation.

Besides this the question of new building construction must be faced. Here it must be remembered that new buildings are permanent and change the face of the villages and small towns. They must therefore be designed to meet the future needs of the people in the villages and towns as well as the immediate situations. School buildings in many rural areas are hopelessly out of date, apart from their inadequacy to meet the situation arising out of evacuation. The policy of

building senior schools in the countryside needs reviving and implementing. Moreover, where premises are lacking or inadequate and no fresh school building has been constructed this situation could often be met by the construction of some type of hall or village centre, which could serve for teaching purposes during the War and afterwards be an asset to the neighbourhood.

The educational position arising out of evacuation abounds in such possibilities of harnessing immediate necessities to future needs and developing national assets rather than frittering away resources in improvisations. What is essential is far-sighted planning and bold leadership inspired by the conviction that a nation's youth is one of its greatest assets, and the wise training of the children and adolescents a sure safeguard of its morale. Only such a conviction will supply the drive essential to carry through the measures required to safeguard the health of the children whether in reception or evacuation areas, to ensure that the diet of the children of the nation is kept at a level affording at least adequate protection against the deficiency diseases, and sufficiently fortified by a good standard of nutrition to be resistant to epidemic infections, thus preserving us the invaluable asset of a healthy and well-developed young generation.

No less determination will be needed to repair the havoc already wrought in secondary and higher education. Here, as Helen Bentwich points out, apart from the acute difficulties imposed by the absence of suitable premises and equipment, billeting offered particular difficulties. In the absence of careful planning of billeting in relation to the actual educational facilities for secondary education in the reception areas, efficient teaching of these children proved almost impossible. Here the evacuation experience endorsed the importance of further regional co-operation in the direction suggested both in the Hadow Report and in a subsequent P E P broadsheet on the control of education.

This Evacuation Survey makes many other admirable suggestions. The chapter on psychological aspects is particularly valuable not only in respect of the warning it gives in regard to juvenile delinquency if we fail to handle wisely the question of small children and separation from their homes, but also in regard to camps and to the needs of parents or foster parents. Some teachers might well consider whether they could not relieve foster parents of some of their heavy responsibilities out of school hours. There are emotional as well as economic problems in evacuation, and the original scheme broke down mainly on the human and domestic side. The vagaries of human relationships were insufficiently considered. Unless the State shoulders its responsibilities in these matters the opportunities for constructive work which evacuation offers will be missed as will the opportunities before the National Youth Committee.

The question really before us is whether we care sufficiently for the welfare of youth to put into its training the thought and effort which are required to meet these new opportunities. A consciousness of the importance of youth as a national asset may provide the first stimulus. Equally our plans must provide for the throwing up of leaders, and for the means by which youth can play its part not only in the national effort now but also in the development of a new social order after the War. This evacuation survey, for all its trenchant criticism of past mistakes or ineptitude, demonstrates emphatically the opportunities still confronting us in social reform in this field of education. If these opportunities are firmly seized, evacuation may yet leave the country a heritage of camp schools, village halls and clubs, nursery hostels and the like such as it has never before enjoyed. Permanent links might be established between urban and rural communities, and a sense of the values of right feeding, of air and sunshine, of child nurture and of social enterprise carried to half the homes of Britain.

To achieve this we need indeed central direction imaginatively alive to these human and social issues, and making wise and effective use of the administrative systems already available. Such direction is needed to ensure due co-ordination not only of the work of the different Government departments but also of such activities as those of the National Youth Committee and the numerous voluntary organizations concerned with the welfare of youth. We need, too, a large and wholesome display of local initiative, exploring and discovering its own solutions for difficulties as they are encountered. Supported by an increasingly enlightened public opinion we may see at last the actual beginning of compulsory day continuation schools until the age of eighteen, the elimination of some of the anomalies of local administration which have hindered the development of our educational system and the implementing of the constructive proposals of the Spens Report and of the provisions of the Fisher Act placed on the Statute Book at the end of the War of 1914–18.

A ZOOLOGY FOR STUDENTS

A Text-Book of Zoology
By the late Prof. T. Jeffery Parker and the late Prof. William A. Haswell. Sixth edition. 2 vols. Vol. 1. Revised by Dr. Otto Lowenstein. Pp. xxxii+770. (London: Macmillan and Co., Ltd., 1940.) 36*s*. net.

IT is nearly forty-three years since "Parker and Haswell" first appeared, and its usefulness has made it about the best-known text-book of zoology of its scope in the English language. During the interval much water has flowed under the bridge, and while five editions have appeared each of them has contained only relatively minor alterations. As is stated in the introduction to the present, that is, the sixth edition of vol. 1, "it was clear that this had to be based on a thorough revision of both text and illustrations". One looks forward to renewing the acquaintance of a friend of such long standing with mixed feelings; pleasure in old friendship and trepidation that the years may have wrought such changes that the friend will no longer be recognizable. The fear may be set aside, for it is the old friend though mellowed and may we say improved with acquired knowledge. Some of the old faults are still present, for example, on p. 1, Linné did not introduce the "binomial" but the binominal nomenclature, and it is preferable to regard the *specific name* as composed of two words, the *nomen genericum* and the *nomen triviale*. The same breezy lack of uniformity is retained in the legends of the illustrations; for example, pp. 400 *et seq.*, we find the same animal referred to indifferently as *Astacus fluviatilis*, *Astacus* or the crayfish. Sometimes this occurs at the beginning of the legend, at others after a preliminary phrase. There is similar diversity throughout: the generic name alone is given or the specific name; either may be in heavy type or in ordinary type or in brackets; the author's name is given in heavy type, in ordinary type, or, more frequently, omitted altogether. This treating of nomenclature as if it were a matter of indifference, while characteristically English, is unnecessary, and in a book that is bound to be used by many young zoologists it would have been as well to have followed a more consistent course.

The first edition contained 752 pages of text and 663 figures while the present one has 744 pages and 732 figures and a larger type has been employed. In spite of fewer pages and larger type, however, the use of a larger page and the elimination of a certain amount of material, now obsolete, has allowed of the inclusion of more useful material. Of the text-figures about eighty are replacements, and since they have been chosen from a much wider range than was available forty years ago each of them constitutes an improvement. The new figures, about seventy in number, similarly add much to the usefulness of the new edition. The book appears to be remarkably free from actual errors or slips, although in the diagram of the eye on p. 36 anterior and posterior chamber are not used in the sense in which they are employed in standard text-books of anatomy—a common fault in text-books of zoology. Posterior chamber is the space between iris and lens capsule and not the cavity containing the vitreous body. On p. 207 "ora uricles" is an obvious slip for auricles. It is scarcely correct to describe *Hirudo medicinalis* as the common British species (p. 355). In a few places also another terminology might be preferred, for example, "unsymmetrical" (p. 154); the terms polype instead of polyp and zoophyte instead of hydroid in the chapter of Coelenterata sound old-fashioned. On p. 324, "deric epithelium" might well have been left as epidermis, and on p. 330 receptaculum seminis might have been left as spermatheca, since receptaculum has a different significance when applied to receptaculum ovorum.

Changes have been made in the classification which were much needed. The giving up of the old "phyla" Nemathelminthes, Trochelminthes and Molluscoidea are steps in the right direction, for the inclusion of the various groups of animals in these phyla suggested a closer relationship than is borne out by their structure. The removal of the Endoprocta, that is, Calyssozoa, from the Bryozoa and the reclassification of the Insecta are more in consonance with modern views and are improvements, as is the more distinct separation of the Chilopoda (centipedes) from the Diplopoda (millipedes). On similar lines it would have been preferable to separate Hydra and its immediate allies more distinctly from the Hydrozoa.

It is easier in a review to direct attention to the faults of a book than to enlarge upon its virtues, and this is the more so in a new edition where past virtues are taken for granted. The present volume is still easily recognizable as "Parker and Haswell" and so characterized by straightforward, concise but nevertheless readable

text and it is illustrated by clear, illuminating text-figures. On the technical side it maintains or rather exceeds the high standard set by the first edition, and those who are familiar with the latter will recognize that this in indeed praise. On the whole a praiseworthy judgment has been exercised in what has been included and what omitted, and also between the old "Parker and Haswell" and the changes necessitated by more modern ideas in zoology. The book is intended for the general student who studies zoology, whether in the university or elsewhere, for two years or so beyond the general first-year course. For this purpose it is excellent and will doubtless maintain the success of its predecessor and enhance its fame.

C. H. O'Donoghue.

A HISTORY OF BIOLOGY

Biology in the Making

By Emily Eveleth Snyder. Pp. xii + 539. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 18*s*.

How is it that we know so much of the structure and life habits of dinosaurs and other prehistoric monsters? Why is it that scurvy, the eighteenth century scourge of seamen and others is scarcely known to-day? How was the relationship between insects and diseases discovered? How did Mendel discover the now well-known laws of heredity? Why is it that to-day surgery is comparatively safe whereas at one time about 90 per cent of the patients died of blood-poisoning?

These are only a few of the many questions in biology and such allied sciences as agriculture, medicine and hygiene which might easily be asked by almost anyone, and the teaching of biology will not be perfected until it makes it possible for almost any secondary school student to answer them. The answers can only be found by studying the history of the science. This view is obviously held also by Miss Snyder, and she has given her valuable aid to teachers and students in a book of absorbing interest by means of which they can trace the development in biological discovery, not by so many facts but (as she says) "as the product of real men whose lives for one reason or another make them outstanding in their fields".

The text is written with such compelling style that it is not necessary to have any former knowledge of biology in order to follow the history of biological discovery. The illustrations are a novel feature of the book. Nearly a hundred portraits of biologists and medical men adorn the pages. Some are especially pleasing studies and many have, so far as we know, never been reproduced in a text-book of this standard before. They range from Aristotle through such well-known men of cience as Leeuwenhoek, Linnæus, Lyell, Agassiz, Darwin, Pavlov, Galton, Bateson and Ross to the more modern workers such as Davenport, Gowland Hopkins, Conant, Blakeslee, A. V. Hill, Starling, Banting, Sherrington, Carrel, and so forth. The inclusion of the work and portraits of so many present-day workers marks the book as a distinct contribution to biological teaching. In the past few years, commendable efforts have been made to bring in the outstanding points of the history of any science by means of portrait studies; but most books seem to shun including the study of outstanding present-day workers. Other illustrations also do much to give the subject life and emphasize humanistic features of biological science. Some taken at random are: Gesner in his museum; Linnæus in his garden; consulting room of a physician of the Middle Ages; Jenner vaccinating a boy; Pasteur in his laboratory (the author stimulates the imagination in this case by reproducing the artist's impression of Pasteur in his laboratory and also a photograph from the film in which Paul Muni took the part of Pasteur; it is a pity these two are not on facing pages, since one is very much struck by the faithful reproduction in the film version); surgeon of the eighteenth century; Hales's experiment at Newgate Prison; Beebe's bathysphere.

Hints for further reading are given at the end of every chapter. At the end of the book there is a chronological list of nineteen pages. We think this would have been more valuable for reference had it been alphabetical instead of chronological. This list is followed by a glossary and the glossary by an extensive bibliography.

Many non-biologists will find this book of absorbing interest, but we would strongly recommend it to all teachers of biology in schools. Those students who have read a good School Certificate text-book in biology and this book simultaneously will leave school with a very broad outlook on biology and its important applications to human life and affairs.

TRENDS IN MATHEMATICAL BIOLOGY

(1) Mathematical Biology

By V. A. Kostitzin. Translated from the French by Theodore H. Savory. Pp. 238. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1939.) 7*s*. 6*d*. net.

(2) Advances and Applications of Mathematical Biology

By Nicolas Rashevsky. (University of Chicago Science Series.) Pp. xiii + 214. (Chicago: University of Chicago Press; London: Cambridge University Press, 1940.) 12*s*. net.

(1) RARELY is a scientific text-book translated from French into English, and one feels that in translating this volume from the well-known "Collection Armand Colin", Mr. Savory has issued a challenge to English biologists to make a better acquaintance with recent applications of mathematics to biology. This excellent translation is certainly of value in directing attention to a book which, according to Dr. Volterra, marks an important date in the progress of mathematical biology. The major part of the book deals with the problems of biological associations and the struggle for existence—problems which, with the help of simple and rather plausible assumptions, can be expressed as first order differential equations. The first ten chapters discuss the solution of these equations. They summarize the pioneer work of Lotka and Volterra on population growth and relations between species, including symbiosis and parasitism; and many of their results are generalized and extended, while the author's critical discussions are always of value.

Among points of particular interest are the ingenious use of Gause's data on cultures of Paramecium to give a further verification of the logistic law (Chapter iv), a plausible attempt to explain sudden fluctuations in numbers of small rodents (Chapter v), and the study of 'residual action' in Chapter viii (cf. Volterra's 'historical' actions). Chapter ix contains an excellent analysis of predator-prey relations and the failure of Volterra's 'classical' fluctuations to represent experimental fact; but further discussion of Gause's 'relaxation' oscillations would have been welcome, and there is no mention of Bailey and Nicholson's theoretical study of balance of populations (*Proc. Zoo. Soc. Lond.*, *551*; *1935*). The remaining chapters, on growth, the forms of living objects and selection, are of less interest; and in particular the assumptions used to develop equations for embryonic and postnatal growth are open to criticism, while the theory of 'superficial excrescences' (pp. 212–14) is not convincing.

The treatment of the book is rather too didactic for so speculative a subject, and the arguments are at times obscure because over-terse. The mathematical notation is difficult but remarkably concise. Experimental analysis of biological associations is clearly urgently needed to test M. Kostitzin's mathematical predictions and the assumptions upon which they are based. Here is plenty of scope for the experimental biologist, and repetition and extension of Gause's pioneer work in this field would be of particular value.

(2) This is a sequel to Dr. Rashevsky's "Mathematical Biophysics" (Chicago, 1938), and describes recent progress in this field. In the first six chapters a new approximation method is developed for studying diffusion in a highly abstract, isolated and homogeneous 'cell', which is no longer spherical, and the results are applied to cell respiration, division and growth, cell forms and movements, and protoplasmic streaming. The new method consists in simplifying the cell beyond all recognition and then dealing only with orders of magnitude, and cannot be expected to throw much light on the complex phenomena of cellular physiology. Nevertheless, the author has followed up his postulates with remarkable ingenuity, and his conclusions are of interest because they show a certain relationship to experimental fact and suggest new lines of research.

In the abstract system under study, diffusion outwards generates forces which tend to round up a small cell but to elongate a large cell, and above a certain critical size these forces may overcome the opposing surface tension and lead to cell division or a non-spherical state of equilibrium. This critical size is found to be of the order of magnitude of actual cells. Since diffusion inwards has an opposite effect, the resultant forces generated by the substances produced and consumed in metabolism may decide whether the cell will divide. It appears that the critical size should be proportional to the inverse cube-root of the oxygen-consumption rate, a conclusion for which slight experimental evidence is adduced, while a high glycolytic coefficient should increase the readiness to divide. The nucleus is dismissed as a "local structural detail". The theory that

rapidly dividing tumour cells have an abnormally high glycolytic coefficient suggests a theory of growth (Chapter iv); but this discussion loses much of its interest in view of recent work by Boyland and Boyland (*Biochem. J.*, 33, 618; 1939), who found little correlation between growth-rate and glycolysis in different strains of grafted tumours. Study of cellular forms and movements suggests that non-spherical cells should round up after death, and experimental evidence on this point and on the effect of various drugs on cell shape would be of great interest.

The remaining chapters summarize the author's abstract mathematical theory of the functions of the central nervous system, and discuss excitation and inhibition, reaction times, discrimination of intensities and perception of visual patterns. This work is still highly conjectural, but the conclusions reached connect up to some extent with experimental evidence.

Dr. Rashevsky's method of analysing mathematically the behaviour of abstract systems from which all irrelevant complexities have been eliminated has been so successful in physics that it holds out promise in biology; but the problems are here more difficult and we are still very far from the systematic mathematical biology which the author envisages. E. C. R. Reeve.

GEOMORPHOLOGY

Geomorphology
An Introduction to the Study of Landscapes. By Prof. A. K. Lobeck. Pp. xii + 731. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 25*s*.

A Textbook of Geomorphology
By Prof. Philip G. Worcester. Pp. viii + 565. (London: Chapman and Hall, Ltd., 1939.) 22*s*. 6*d*. net.

THE increasing use of the word 'geomorphology' may be regarded as symptomatic of the emancipation of the science from parental control; for as a hybrid science, the offspring of geology and geography, its early footsteps have hitherto been guided in the direction dictated by one or other of its parents, so that it was either 'physical geography' or 'physical geology'. Now the science has its own journal, less than two years old, and a rapidly growing literature which is steadily developing its own technique, and a personality quite distinct from its parents.

In the two books under review the subject-matter is much the same but the treatment differs vastly; it may be said that while Prof. Lobeck is a geomorphologist, Prof. Worcester still follows the tradition of physical geology. While both explain the operation of weathering and erosion in shaping the features of the earth's crust, the latter is concerned mostly with the 'process' and the former with the 'product' at each stage in an evolutionary process, tracing, with delightful clarity, the development of land-forms from youth, through maturity to old age in each structural type and under each denudational process.

In both books is recognized the importance of illustration as an aid to description, for words alone can never adequately portray the subtle but significant variations of form in landscape. Prof. Worcester relies mainly on the photograph, supplemented by line drawings, but Prof. Lobeck brings to bear his great skill as a draughtsman and uses the block-diagram to isolate and demonstrate the physiographic essentials of a landscape. These are not simply illustrations, but are, as it were, an essential part of the text, built into it and amplifying it.

Though unnumbered, there are about five hundred of these, varying in size from 4 sq. in. to full-page drawings, and, in addition, each chapter is introduced by about a dozen beautiful photographs, illustrating the land-forms to be described in that chapter. In this way the unnatural simplification of the idealized block-diagram is corrected by the view of the actual scene, but the diagram, in its turn, analyses and explains the landscape. Treated in this way the block-diagram becomes a most effective instrument for teaching, and it is in this function that Prof. Lobeck excels. There is an early chapter, too, on scientific method and presentation which is very helpful and suggestive to teachers and learners alike. The striving after clarity, simplicity and mental tidiness sometimes leads the author into the error of excessive orderliness in what is, after all, not an exact science; as an example we may quote his recognition of 'mature stages' in each evolutionary series of land-forms; these are always carefully defined, but the definition is often highly arbitrary and not always generally accepted.

Prof. Worcester's book is much more conventional and follows the high traditions of such standard works as Salisbury's "Physiography".

A. A. Miller.

ELECTROMAGNETIC THEORY

Static and Dynamic Electricity

By Prof. William R. Smythe. (International Series in Physics.) Pp. xviii+560. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 40*s*.

FOR some time there has been a crying need for a standard text-book on electromagnetic theory, which should give a concise summary of its fundamental principles, and should illustrate them by abundant reference to problems of practical physics and technical engineering. The classical treatises by Jeans and Livens give admirable accounts of the basic laws of electromagnetism, of the mathematical analysis required in problems and of the semi-philosophical problems which lie at the root of the speculative parts of the theory. But it was not their aim to deal in any detail with practical applications or to present the results of the theory in a form adapted for use in research. This magnificent text-book by Prof. W. R. Smythe has as its express object to exhibit the theory of electricity and magnetism in direct relation to problems of research.

The reviewer has used this book in connexion with a variety of practical problems since its publication last November and has never met with disappointment. Every possible aid to the research worker has been given by the author, even to the detail of noting at the foot of each page the system of units employed thereon. The results are always given in the most practical form. Thus, for example, the magnetic field due to a circular loop is not expressed as a useless, slowly convergent series of zonal harmonics but as elliptic integrals which can be rapidly evaluated from tables.

There is a twenty-page index and a careful appendix comparing in detail the standard systems of units. Vector notation is employed throughout. There is a good introduction to the special theory of relativity and also to wave mechanics. The requisite mathematical analysis is developed as required, but space is saved by referring the student to standard tables of integrals for the more elementary results. This treatise should take its place with those of Jeans and Livens as an indispensable help to every research worker in electromagnetic theory. G. Temple.

INDIAN PHILOSOPHY

A History of Indian Philosophy

By Dr. Surendranath Dasgupta. Vol. 3. Pp. xiii+614. (Cambridge: At the University Press, 1940.) 35*s*. net.

ALL those who are interested in Indian philosophy, and especially the readers of the first two volumes of this excellent standard and scholarly work, will welcome the publication of the third volume as well as the news that the manuscript of the fourth volume is ready. Prof. Dasgupta's remarkable exposition of Indian thought brings home to philosophers that the history of their subject is incompletely assessed and understood without a general knowledge at least of Eastern thought. The difficulty of perusing manuscripts in Sanskrit and other old tongues of the Dekkan Peninsula is minimized by the painstaking and judicious study carried out by Prof. Dasgupta, and the results of which are given in his great work.

The present volume deals more specifically with the religious philosophy of southern Indian schools, which are not orthodox for the most part with regard to official Brahmin thought. The Pañcavātras, for example, are considered of a lower caste and value by the orthodox Brahmins. This volume deals in turn with the Bhaskara school, the Pañcavātras and the Arvars, the Visistadvaita, Yamunacarya, the important Ramanuja school and the Nimbarka doctrines, and the Vijnana Bhiksu. The book ends with a detailed exposition of selected Puranas and the usual bibliographies and indexes.

The analysis of these teachings shows the alertness and depth of Indian thought at its best, whatever be their orthodoxy. Problems of knowledge, of religious psychology, of moral experience are well illustrated. The discussion of the nature of time according to Venkatanatha, to take one instance, is very illuminating, and exhibits the closeness of the Indian views with some Western doctrines. In fact, the comparative value of Indian philosophy is one of the characteristics that should induce European scholars to give more time and thought to it. T. Greenwood.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. (1) System-Nummer 59: Eisen. Teil F II, Lieferung 2: Nachweis und Bestimmung von Fremdelementen in Eisen und Stahl. Pp. xvi+165+388. 27 gold marks. (2) System-Nummer 59: Eisen. Teil C, Lieferung 2: Prüfung der Kerbschlagzähigkeit. Pp. viii+288. 33 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1939.)

(1) AFTER dealing in full detail with all the commoner analytical methods for the detection and estimation of titanium, aluminium, cerium, thorium, nickel and cobalt in iron and steel, the application of more modern methods is described in the part of "Gmelins Handbuch" under notice. Although no details are as yet available in the literature for the use of the chromatographic adsorption method of analysis, which has hitherto been used almost exclusively with organic compounds, its application by Schwab to the analysis of steels appears to be so promising that details of the process are given much more fully than might have been expected. Results which have been obtained with Heyróvský's polarographic method of using a dropping mercury cathode and a large mercury anode with gradually increasing voltage have shown that, after removal of the iron from the solution, an extremely sensitive and rapid method of qualitative and quantitative analysis of other elements is available. Photographic records can be obtained, but where speed is required they may be replaced by visible readings on a mirror-galvanometer scale. Perhaps the most sensitive method of all for qualitative analysis is that of spectrum analysis, which is fully described. Standard methods adopted by Australia, Canada, France, Italy, Japan, the U.S.S.R. and the United States are tabulated at the end. No standard methods have been adopted by Germany, and Great Britain is not mentioned.

(2) The extraordinary thoroughness with which the editors of "Gmelins Handbuch" are dealing with the metal iron is clearly shown by the issue of several highly specialized sections, of which this, which deals only with the notched-bar impact test for the toughness of iron and steels, is a sample. The chemist will find little of immediate interest, but the numerous drawings of machines, photographs of actual tests, graphs of physical properties and tables of reference to original papers should make it a valuable work of reference to engineers and metallurgists.

Chemische Physik der Metalle und Legierungen

Von Prof. Ulrich Dehlinger. (Physik und Chemie und ihre Anwendungen in Einzeldarstellungen, Band 3.) Pp. xi+174. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 12 gold marks.

MUCH exact experimental work has been carried out in recent years on metals and their alloys, and the knowledge of transformations of the crystal lattice, such as occur in plastic deformation, in the separation of a new phase, or in the change from a disordered to an ordered structure, has been greatly advanced. Progress has also been made in the description of the metallic state in terms of quantum mechanics. The stage has not yet been reached, however, at which the chief properties of a metal or alloy after a given treatment can be arrived at by deduction.

The work of Dehlinger, himself an active investigator in this field, aims at interpreting the relations between experiment and theory, especially for the benefit of the metallurgist. He treats of the thermodynamics of phase equilibria, with the distribution of electrons among the atoms, leading to the Hume-Rothery and similar rules, with the various types of structure among alloys, and with ferromagnetism. The last portion of the book deals with the kinetic aspects, such as diffusion, allotropic change, and precipitation of a new phase from solid solution. Plasticity and the mosaic structure of metallic crystals are only touched upon. Perhaps the most interesting sections are those which deal with the different forms of precipitation, including age-hardening. The book was probably completed too soon to include the important discoveries of Preston and Guinier on the nature of the initial stages of precipitation. Although German work receives most attention, an effort has evidently been made to cover the literature, and there is a useful bibliography.

C. H. D.

British Blood-Sucking Flies

By Dr. F. W. Edwards, H. Oldroyd and Dr. J. Smart. Pp. viii+156+45 plates. (London: British Museum (Natural History), 1939.) 15*s*.

THE predecessor of this book entitled "Illustrations of British Blood-Sucking Flies" was written by the late E. E. Austen and published in 1906. Within a few years the edition was exhausted, and it evidently filled a definite need. Its successor is a larger and more informative work the aim of which is similar, and that is to provide information of interest to the non-specialist in the simplest possible manner. Increase in knowledge of blood-sucking flies since the 1906 volume has been great. Thus, in that year about 2700 species of British flies are stated to have been known, including 74 that are actually, or potentially, blood-suckers. In the intervening thirty-two years these figures have increased to 5,200 and 117 respectively. Much more important than mere additions of species is the notable increase in knowledge of their life-cycles and behaviour.

This volume deserves all praise: it gives the right kind of information required by the non-specialist and avoids irrelevant detail. The accounts of the species are supplemented by 45 excellent three-colour process plates. If a new edition of this work be called for, the practical aspect of the subject might receive more detailed consideration. A short section on the treatment of mosquito and other insect 'bites' by alleviatory measures or by repellents need not occupy much space but would be welcomed. We hope that the Trustees of the Museum will bear in mind the importance of issuing works, like the present one, of more general interest as well as those that only appeal to a small coterie of specialists and, sometimes, very few of them British subjects.

A. D. I.

FARMING WITHOUT SOIL

By SIR JOHN RUSSELL, F.R.S.,
ROTHAMSTED EXPERIMENTAL STATION

IN the days before the War, which now seem to us so incredibly peaceful and remote, we were suddenly startled by Press announcements that an American professor had discovered how to farm without soil, and visions were evoked of intensive methods that would revolutionize crop production. One journalist went so far as to assert that all the wheat needed by Great Britain could, on this new method, be grown on an area the size of Euston Station.

When details became available the method proved to be the growth of plants in culture solutions, familiar to generations of botanical students under the name 'water cultures', and the fantastic claims had been arrived at by multiplying the area of the water culture vessel sufficiently to convert the square centimetres into acres. The claims must have been very embarrassing to Prof. Gericke, the originator of the method[1], and indeed the Department of Plant Physiology of the University of California with which he is associated took the unusual step of issuing a statement with the purpose of damping irresponsible enthusiasm and restoring some sense of perspective to what was actually an interesting application of botanical science.

It is unnecessary to remind botanists that perfect plant growth is possible in culture solutions provided the proper nutrients are given and certain conditions are maintained. The difficulty is to pass from the small scale of the laboratory to the large scale of the commercial market gardener and farmer, and only those who have had to make this transition know what it means. Prof. Gericke has shown how the large-scale grower can carry out water culture; he has worked out the conditions for a number of typical American crops, and indicated the difficulties likely to arise. Those with much experience of water cultures know the difficulties of getting really good results in the laboratory. The nutrient solution must contain not only the six or seven classical elements needed in relatively large quantities, but also those elements needed in small amounts only, especially iron, boron, manganese, copper; but as these trace elements are harmful in larger quantities it is necessary to use purified salts in research work. Due regard must also be paid to the changing requirements of the plant as it develops, arising from the circumstance that a given nutrient has different effects at different stages of the plant's life, while the reaction of the medium must also be controlled, as it tends to change during plant growth, and, if as often happens, it becomes alkaline, the iron is precipitated. The air supply to the roots is of vital importance, and steps must be taken to avoid the growth in the solution of algæ, bacteria and other micro-organisms which interfere with the proper course of the experiment. One looks to see how these difficulties are met, but apparently they cause less trouble on the large scale than in the laboratory. Prof. Gericke finds it necessary to have only one basic formula for all his crops, the salts need not be pure, no special precautions are taken about mixing them and neither aeration nor growth of micro-organisms in the solution caused trouble. Further, the solutions need not be changed frequently as in good laboratory practice; in some cases they even remained in use for a year. Distilled water, so essential in laboratory cultures, is obviously out of the question; tap or well water must be used instead, but so long as this is not heavily charged with salts it does not seem to affect the procedure.

The process is not, however, entirely simple. Iron may be thrown out of solution, or be present in inadequate amounts, and during the course of growth there may arise deficiencies of other elements. These could be detected by chemical analyses, but a simpler procedure is possible: the plant itself shows up the deficiencies by fairly characteristic symptoms which a good grower soon learns to recognize. These symptoms are described and illustrated, and this section gains in interest from the fact that the plants include some such as rice and cotton, which are not usually grown in laboratory exercises in Great Britain.

While recognizing the author's wide experience with water cultures, one cannot help wondering whether the absence of these and other difficulties may not in part be attributable to the clear and sunny skies of California, and whether large-scale experience would be equally fortunate in Great Britain, where conditions of temperature and light are often so different.

In a recently published book[2], details are given to help the grower. In laboratory practice the seeds are germinated in sand, sawdust, or moist blotting paper. On the large scale a seed bed is

used, consisting of a tray of wire netting of one inch mesh and 19 or 20 gauge held on a frame 6–12 ft. long by 2–4 ft. wide, and containing moist litter—peat, fine wood shavings (wood wool), chaff, etc. After germination the seeds push their roots through the wire; the tray is then placed over the solution, and the roots dipping into it absorb the nutrients and proceed to elongate. In the laboratory water cultures are by long custom made in glass vessels—usually bottles—each containing one plant. On the large scale basins are used; so far it is not certain whether the best material is concrete, wood, sheet metal or such cheaper materials as troughs dug in the earth and lined with puddled clay. For all of them satisfactory results are claimed, especially after they have been in use, so that harmful substances have been dissolved out; in the case of metals, coating with asphalt enamel may be desirable. The whole problem of root aeration is avoided by the simple expedient of restricting the depth of the basin to six inches, and allowing sufficient space between the surface of the solution and the crown of the root to ensure movement of air. This depth also permits of evaporation and transpiration of about half the solution without detriment to plant growth. Greater depths required more of the chemicals and presented no corresponding advantage. Some of the basins described were up to 150 ft. long and 50 ft. wide.

The new method is complicated by the circumstance that each crop requires rather special treatment. Experience in ordinary cropping is no guide: two species, the author tells us, which behave similarly in soil might differ markedly in their reaction to water culture. There is also, he says, much less margin of safety in water culture than in soil; the solution "has a much lower resistance to chemical change than does the soil". Detailed instructions for a number of crops are given. The management of the seed bed is particularly important: it must be kept sufficiently but not excessively moist and the temperature conditions must be right. The crops must be closely watched for deficiency symptoms: lack of iron is made good by adding ferrous sulphate, lack of other elements apparently by adding more of the basic mixture.

Tomatoes are said to be among the best 'subjects', and some glowing descriptions are given of results obtained. In good glasshouse practice in England yields run about 6 lb. of fruit per plant: the author claims an average yield of 16 lb. and his highest yield was 27·4 lb. Potatoes in Great Britain average about 7 tons per acre, but a good grower will not uncommonly obtain 12 tons per acre: the author claims 48 tons per acre. Obviously if results of this order were generally obtainable the new method would revolutionize food production.

Incidentally, Prof. Gericke claims that the produce obtained by the new method is of high quality and of full nutritive value, thus ranging himself against those who regard humus as necessary for healthy crop production.

All those who have long been associated with agriculture are familiar with claims of new and vastly improved methods of production periodically put forward: after a short period of public interest they have practically all faded away: on the large scale they did not work. It still remains to be seen what will happen to this latest addition to the list. Three tests have already been made in Great Britain by competent and recognized authorities. From the Cheshunt Experimental Station[3], which specializes on crop-growing under glass, and has had very wide experience with tomatoes and cucumbers, it is reported that the new method yielded 3–4·7 lb. of tomatoes per plant according to the variety, this being lower than is obtained in ordinary soil culture, but 160 lb. of cucumber per plant, as against about 50 lb. in normal practice. Millard and Stoughton at Reading[4] obtained as good yields of tomatoes with the new method as with the old, and better results with gladioli; they could, however, find no evidence of the high yields claimed in California, and doubt whether English conditions of light and carbon dioxide supply would permit of them. Templeman and Watson[5] did not obtain as good yields as in soil. All these experiments go to show that in English conditions, at any rate, the method is not as promising as is claimed, though it may still have its uses for special purposes.

Among these may be town gardening. A Pelican Special has been issued giving in diary form Mrs. Hillyer's trials made for amateurs at her house in Hampstead, and therefore likely to appeal to townspeople who are interested in gardening and are fond of trying something new, but who lack garden space[6]. It is evident that she enjoyed the work, and her energy and enthusiasm enabled her to overcome many difficulties. In her view the new method provides a fascinating hobby, and indeed she thinks it offers "immensely more". The *Daily Mail* has given her space on the roof of its offices, and the services of its expert, Mr. Izzard. Here at least may be possibilities for development.

[1] Nature, **141**, 536 (1938).
[2] The Complete Guide to Soilless Gardening. By W. F. Gericke. Pp. xvi+285. (London: Putnam and Co., Ltd., 1940.) 12*s*. 6*d*. net.
[3] Annual Report, 1939, p. 13.
[4] *Sci. Hort.*, **7**, 174 (1939).
[5] *J. Min. Agric.*, 1938–39, **45**, 771 (1938–39).
[6] Hydroponics: Food without Soil; a Journal of Experiments, 1938 to 1940. By C. Isabel Hilyer. (Pelican Special S63). Pp. 116. (Harmondsworth, Middx., and New York: Penguin Books, Ltd., 1940.) 6*d*. net.

FUNDAMENTAL ASPECTS OF RADIO COMMUNICATION

A JOINT meeting of the Institute of Radio Engineers and the American Section of the International Scientific Radio Union was held at Washington, D.C., on April 26, 1940. Fifteen papers on the more fundamental aspects of radio communication were presented.

H. T. Stetson, of the Massachusetts Institute of Technology, Cambridge, Mass., reported on a comparison of field strength measurements with auroral occurrences and ionospheric disturbances during 1930–40. His results indicated that, beginning six days before the date of the aurora, field strengths of 770 kc./s. were abnormally high with a maximum intensity occurring on the average four days before the date of the occurrence of the aurora. From three days before until two days after the auroral occurrence field strengths decreased to a minimum and remained abnormally low until about six days after. For higher frequencies involving the F layers the auroral occurrences were compared with the transmission disturbance figures of the Bell Telephone Laboratories. Transmission disturbance was a minimum four days before the auroral occurrence, rose rapidly to a maximum one-half day following the dates of auroras, and then subsided to near the average value six days after the dates of the auroras. These results led to the conclusion that maximum transmission disturbance follows auroral phenomena and that the F layers are affected on the average about one day earlier than the E layer, based on more than three hundred days of observations utilized.

J. Bartels of the Carnegie Institution of Washington, N. H. Heck of the United States Coast and Geodetic Survey, and H. F. Johnston of the Carnegie Institution of Washington, all of Washington, D.C., described a new measure of geomagnetic activity, the three-hour-range index K. Each collaborating magnetic observatory assigns to each of the eight three-hour intervals of the Greenwich day one of the integers 0–9 as a range index K, by a method which effectively separates the two main solar influences on the ionosphere, namely, P (supposedly due to particles, and strongest in polar regions) and W (supposedly due to wave-radiation, restricted to the daylight hemisphere). It was described how P was measured by K, and a scheme for a geomagnetic record of W was sketched.

J. H. Dellinger and N. Smith of the National Bureau of Standards discussed the reliability of predictions of ionospheric characteristics and radio transmission. Starting more than a year ago, predicted values of critical frequencies and maximum usable frequencies were published monthly for the month following that of publication, in the *Proceedings of the Institute of Radio Engineers*. These published predictions were compared with the values afterwards measured. The results showed that the expected accuracy originally stated, 15 per cent, had been well met. The limit of accuracy is determined by the minor unpredictable variations of solar activity from its trend in the 11-year cycle.

L. V. Berkner and S. L. Seaton of the Carnegie Institution of Washington reported some phenomena in the F_2 region during geomagnetic disturbance. The ionospheric effects of ionosphere storms at an equatorial station were found to be similar to the well-known effects in temperate latitudes at night, but in the daytime the critical frequencies increased during a storm instead of decreasing, as they usually do in a temperate latitude.

In a paper by Messrs. Gilliland and Taylor, of the National Bureau of Standards, results were reported on ionosphere measurements during the eclipse of April 7, 1940. The recombination coefficient in the E layer was found to be approximately 10^{-8} and that in the F_2 layer less than 10^{-10}.

Olof E. H. Rydbeck of Harvard University showed that from a wave-mechanical interpretation of the propagation of electromagnetic waves in an ionized medium it was possible to calculate the true height of reflection from the virtual-height-frequency records. Thus the actual electron distribution could be obtained from experimental data.

K. A. MacKinnon of the Canadian Broadcasting Corporation, Montreal, Canada, reported some field intensity measurements of 540-kilocycle ground-wave propagation over the high-conductivity prairie provinces. The ground conductivities approached 10^{-12} electromagnetic units with a maximum near south central Saskatchewan. In certain directions the earth was electrically uniform to distances of about 400 miles.

I. E. Mouromtseff of the Westinghouse Electric and Manufacturing Co., Bloomfield, N.J., discussed forced-air versus water-cooling of large vacuum tubes. Mechanical and thermal limitations of air cooling devices were described. General rules for designing an air cooler were described.

Prof. E. L. Chaffee of Harvard University discussed space-charge relations in triodes and the characteristic surface of large vacuum tubes. It

was shown theoretically and from experiments that the plate, grid, and total currents, in the absence of secondary emission, varied as the 3/2 power of the plate voltage along lines of constant $L = e_{go}/e_{po}$, where e_{go} and e_{po} were measured from a displaced origin. The three currents were then expressed in the form $i = Ae_p^{3/2}(1+\mu L)^{3/2}F(L)$. The entire system of static curves for each current can be expressed by a single curve. A simplification in the experimental determination of the static curves was suggested, permitting the static curves to be plotted from a few measurements at low power. The effects of secondary emission were discussed and curves were given which would aid in the design of tubes in which secondary emission from the plate was suppressed.

Prof. W. G. Cady of Wesleyan University, Middletown, Conn., reported a new method for the determination of the axes of quartz crystals by means of etch figures. A. de Gramont has shown that when a beam of light is passed through a quartz-crystal slab, one face of which has been etched with hydrofluoric acid, the rays are refracted in different directions, so that a lens placed close to the crystal projects on to a screen an image that is characteristic of the particular face that has been etched. If the etched surface is normal to the optic axis (Z-axis) the pattern takes the form of a three-pointed star, the points indicating the direction of the X-axis with a precision of about a degree. In repeating Gramont's experiment the author found that the pattern could be viewed directly through a powerful lens, for example, a $\frac{1}{4}$-in. microscope objective. The method furnished for the first time a simple and accurate optical method for finding the direction of the electric axis on a Z-cut slab of quartz.

Prof. Karl S. Van Dyke of Wesleyan University, Middletown, Conn., discussed the use of an etched sphere of quartz in identifying the orientation of quartz plates. He pointed out some discrepancies and contradictions in published papers, particularly as they related to the distinction between right and left quartz and the temperature coefficient of various 'cuts' of quartz resonators. This paper aimed at rectifying the discrepancies and contradictions which appeared in and caused confusion in the literature. Numerous papers involving discrepancies were specifically cited. All the factors concerned, etch figures, optical rotation, electrical polarization, and resonant frequencies, were in entire agreement with the elastic constants given by Voigt, and his equations for rotating the axes of reference, when used with his conventions as to axes and signs of angles. Taken together they made it possible to determine the peculiar and sometimes unstated conventions used by others in their published data.

C. R. Englund, A. B. Crawford, and W. W. Mumford of Bell Telephone Laboratories, Holmdel, N.J., discussed the diurnal variation of ultra-high-frequency optical-path transmission. Continuous records of ultra-high-frequency transmission on frequencies of 75 and 150 megacycles per second over a good 'optical' path showed variations in the received field. These variations were explained as being caused by wave interference, an interference which varied with the changes in the composition of the troposphere. The diurnal meteorological factors which affected the transmission were discussed.

Andrew Alford of Mackay Radio and Telegraph Co., New York, N.Y., and Sidney Pickles, International Telephone Development Co., New York, N.Y., described an ultra-high-frequency voltmeter of new design. This was made up of a current-indicating instrument associated with a closed quarter wave-length of line. The quarter wave-length of line was adjustable for a range of frequencies. The instrument was calibrated and held calibrations within the limits of engineering accuracy. Voltages instead of currents were then used with calculated surge impedances to measure transmitted power.

R. W. George of R.C.A. Communications, Inc., Riverhead, L.I., N.Y., reported on field intensity of motor-car ignition between 40 and 450 megacycles per second. The average field intensity varied about 2 to 1 over the frequency range. Vertical and horizontal polarization were compared and showed slightly greater field intensity for vertical polarization. New cars, old cars, and trucks showed no large differences of ignition field intensity.

Andrew Alford of Mackay Radio and Telegraph Co., New York, N.Y., discussed currents induced in wires by high-frequency electromagnetic fields. The experiments and theory showed that, except in special cases when resonance phenomena predominated, the induced currents were not even approximately sinusoidally distributed and that, therefore, theories based on the *a priori* assumed sinusoidal distributions were limited to wires of certain special resonant wave-lengths.

During the morning of April 27 an ionosphere conference of about forty persons was held at the Department of Terrestrial Magnetism, Carnegie Institution of Washington. The principal subjects discussed informally were: results of ionospheric observations during the solar eclipse of April 7, 1940; effects of magnetic storms on transmission conditions; methods for determining true heights of ionosphere layers; methods for predicting magnetic and ionospheric conditions; measures of radio transmission disturbance; the new range-index for measuring magnetic activity; present status of the Lorentz polarization correction.

OBITUARIES

Prof. E. W. W. Carlier

PROF. E. W. W. CARLIER died on September 2, 1940, in his seventy-ninth year at his home in Warwickshire. In him has passed away an outstanding personality.

Prof. Carlier was of French extraction, being the only son of Antoine Guillaume Carlier, officier d'Académie. He was born at Norwich in 1861, and received his early education at the King Edward VI School there. Later, he went to the Lycée de Valenciennes, where he graduated Baccalauréat és Sciences. He began his medical education at the University of Edinburgh at the age of twenty-one, and took the degree M.B., C.M., with honours in 1886. After this, he was asked to join the junior staff in the Department of Physiology. He obtained the M.D. degree with first-class honours and gold medal in 1891. In 1895 he was appointed senior lecturer in physiology.

In 1899 he went to Birmingham as professor of physiology in Mason College, which in 1900 became the University of Birmingham. He held the professorship of physiology in the University of Birmingham until his retirement in 1927, when he was elected emeritus professor.

During 1909–14, Prof. Carlier was examiner in physiology for the first fellowship examination of the Royal College of Surgeons. He was vice-president of the Physiological Section of the British Medical Association at Ipswich in 1900, and at Birmingham in 1911. He was a member of the Royal Society of Edinburgh, and of the Royal Entomological Society. For seven years he was honorary secretary of the Scottish Microscopical Society and vice-president for one year.

In 1895 he married Hannah Culver of Hughenden, who died in 1929. He leaves a daughter and two sons.

When he was at the University of Birmingham Prof. Carlier was instrumental in the building and equipment of a new histological laboratory, which was admirably adapted to its purpose. He conducted the classes in histology himself; his descriptions of the slides were a marvel of lucidity; he saw to it that first-rate material was supplied, and many of his own magnificent preparations were distributed to the students, whose work he superintended individually. At each session students were privileged to examine slides from his unique private collection, which is of European reputation, and which, at the request of the British Museum, is now being sent there.

Prof. Carlier carried out a large amount of research work, many of his papers being published in Germany and France. Perhaps his greatest contribution to physiology was the combination he made of experimental and histological methods as exemplified in his discovery of the functions of the nucleolus in cellular fatigue, his work concerning the changes observable in the gastric secreting cells during digestion, and the secretion of ferments by the liver cells.

Besides physiology, Prof. Carlier took a keen interest in other branches of science, particularly natural history; he was seven times president of the Birmingham Natural History and Philosophical Society. He made a special study of entomology, and since his retirement was engaged in research on the Lepidoptera. He had a very fine collection of butterflies. He was an enthusiastic gardener, and his class was often cheered by the sight of some special flower in his buttonhole or on his table. At the age of seventy he began a research on the Rotatoria, Rhizopoda, and Heliozoa, for staining which he invented a laborious, but very effective process.

Prof. Carlier had a tall and imposing appearance, and students at first were apt to be intimidated by his somewhat abrupt manner and penetrating look, but they soon discovered his genial kindliness, readiness to help in any difficulty, and genuine liking for young people. Women owe him a debt of gratitude in that he upheld their claim to a medical education when this met with much opposition.

Prof. Carlier was deservedly popular, and was held in affectionate esteem by his colleagues, laboratory assistants and students. He will be missed by a large number of friends. HILDA WALKER.

Dr. W. E. Harper

DR. WILLIAM EDMUND HARPER, who died on June 14, at the age of sixty-two, had been director of the Dominion Astrophysical Observatory since 1936. Dr. Harper was born in Ontario on March 20, 1878, and graduated from the University of Toronto in 1906. On that day he received word of his appointment to the staff of the Dominion Observatory at Ottawa. For thirteen years he was engaged there in the determination of the orbits of spectroscopic binaries, and on his transfer to Victoria, when the Government sponsored the 72-inch reflector, he continued the same work. In 1924 he was made assistant director, and finally director in 1936. From the time of his graduation until his death he was intimately associated with the development of astronomy in Canada. Before his death he had determined the orbits for more than a hundred binaries. No other astronomer has approached this number. His contributions to this part of astronomy constitute approximately one quarter of the known orbits. Among other major pieces of work were the determination of 1,100 spectroscopic parallaxes and the measurement of over 7,000 plates for radial velocity.

Dr. Harper took a very active part in popularizing astronomy in Canada. He was a member of the Royal Astronomical Society of Canada and served

on the executives at Ottawa and Victoria and was president of that national society for the years 1928–29. He also sponsored a series of popular astronomical articles for the Press, and the revenue from these articles was devoted to a trust fund for the encouragement of amateur astronomy under the auspices of the Society. For many years he gave monthly radio talks on astronomical topics which did much to stimulate interest in the subject throughout the Dominion and even farther afield.

Dr. Harper's services to astronomy were well recognized throughout the astronomical world. In 1913 he was made a fellow of the Royal Astronomical Society of Canada. In 1924 he was elected to the Royal Society of Canada, and in 1935 the University of Toronto, on the occasion of the dedication of the David Dunlap Observatory, conferred on him the degree of doctor of science. In 1938 he was appointed as official Canadian delegate to the General Assembly of the International Astronomical Union at Stockholm. It was while absent on this trip that he was taken seriously ill with pneumonia. For several weeks he lay critically ill in Rostock Hospital and the international crisis finally necessitated his removal by ambulance to Denmark and thence to England. He returned to Canada in October somewhat improved and attempted to carry on, but suffered a serious relapse the following spring which a year later proved fatal. In his death, Canada has lost a very worthy citizen and a distinguished man of science.

R. K. Young.

Mr. R. M. Wilson

The sudden death on September 15 of Mr. Robert Melville Wilson, principal of the South-Eastern Agricultural College at Wye, has removed a notable figure from the British agricultural educational world.

Mr. Wilson was fifty-four years of age. He graduated at the University of Edinburgh and gained the national diploma in dairying. He obtained a Carnegie scholarship for research in mycology at the Heriot Watt College, Edinburgh, and in 1910 became a lecturer in agriculture for East Lothian and Peebleshire. In 1911 he became lecturer in agriculture and dairy farming at the East Anglian Institute of Agriculture, Chelmsford, where he performed splendid work in enhancing the reputation of the Winter School and Dairy School. In 1914, after holding an inspectorship in the Education Branch of the (then) Board of Agriculture, Mr. Wilson returned to the East Anglian Institute as principal and agricultural organizer for Essex. Several administrative appointments were held concurrently with the principalship at Chelmsford, and in 1920 Mr. Wilson was elected a member of the Council of Agriculture for England.

In October 1922 on the resignation of Principal M. J. R. Dunstan, Mr. Wilson was appointed to the principalship of the South-Eastern Agricultural College at Wye. From the day of his arrival Mr. Wilson continued to build the reputation of the College both as an educational and research centre. His constant interest in every aspect of the College's many activities was evinced by the enthusiasm with which he described to others the work that the various members of his staff were doing. He was always ready to devote time and energy to solving the difficulties of research workers, teachers and students alike, and was never too busy to discuss with any member of the College the problems or interests of his particular branch of study or research, and to bring the keenness and enthusiasm of his own nature to bear with vitalizing encouragement upon the question at issue. At all times Mr. Wilson was an idealist, he expected the best and believed the best of everybody. He was a great believer in the educational value of the pursuit of the solution of original problems in horticulture and agriculture and he encouraged students to take this view in their work. He kept in close contact with old students and was enthusiastic about their successes and ever ready to help them to progress in their careers.

At the outbreak of War Mr. Wilson threw himself into the task of training members of the Women's Land Army, and the kindly and understanding way in which he carried this out was much appreciated. It was a great satisfaction to him to re-open the College in January for the ordinary courses and a corresponding disappointment when it was found impossible to continue this autumn. He felt deeply the break with students and with members of his various staffs who were taking up new work, and no doubt this told heavily upon him. One who never spared himself, he was loved and respected by all who knew him, and heartfelt sympathy goes out to Mrs. Wilson and members of the family in their bereavement.

We regret to announce the following deaths:

Prof. Max Cloetta, formerly director of the Pharmacological Institute, University of Zurich, aged seventy-two.

Mr. E. P. Van Duzee, curator of the Department of Entomology, California Academy of Sciences, on June 2, aged seventy-nine.

Prof. J. Goldschmidt, formerly director of the Berlin Institute of Criminology, aged sixty-six.

Sir Robert Hadfield, Bart., F.R.S., metallurgist and industrialist, on September 30, aged eighty-one.

Mr. F. C. Hart, manager of the Optical Lantern Department of Messrs. Newton and Co., Ltd., scientific instrument makers, on September 4, aged sixty-three.

Mr. F. H. Hooper, formerly editor of the "Encyclopædia Britannica", manager during the War of 1914–18 of the New York office of the Ministry of Food, on August 16, aged seventy-eight.

Mr. Cherry Kearton, the pioneer in popular natural history photography, on September 27, aged sixty-nine.

Colonel J. J. M. Shaw, consulting surgeon to the Army of the Middle East, a member of the National Radium Commission, aged fifty-four.

NEWS AND VIEWS

A Standard of Protection against Incendiary Bombs

IN response to a demand for materials and treatments of comparatively low cost which would afford a useful degree of protection against incendiary bombs, though not necessarily as high as that required of the incombustible material conforming to specification BS/ARP No. 27, the British Standards Institution has issued a new specification designated BS/ARP No. 47. This deals with the testing of incombustible material providing a minimum standard of protection against incendiary bombs. The specification fixes a standard of protection such that materials conforming therewith will (*a*) markedly reduce the lateral spread of fire on protected surfaces; (*b*) markedly retard or even prevent entirely the outbreak of a destructive fire; and (*c*) markedly reduce the damage to protected timber floors, usually confining it to the slow burning and charring of a square foot or so of boarding. It is emphasized that the adoption of protection to the standard fixed by the specification does not obviate the necessity for active defence against bombs by the stirrup hand-pump or other fire-fighting appliance. By retarding the effects of the bomb, the time during which it or the resultant fire may be effectively dealt with is appreciably increased. Copies of the specification are obtainable from the Publications Department of the British Standards Institution, 28 Victoria Street, London, S.W.1.

Empire Drug Cultivation

THE memorandum on medicinal herb production recently issued by the Ministry of Health (NATURE, Sept. 21, p. 397) confined its observations to the four important drugs, belladonna, digitalis, hyoscyamus and stramonium. It is not surprising that other authorities have taken up the matter at the point where the Ministry left off. An official body representative of the medical profession has recommended that in addition to the four drugs which the Ministry of Health has taken under its care, the production of the following items of vegetable materia medica should be encouraged in Great Britain: anethum, caraway, chondrus (Irish moss), colchicum, Filix-mas, valerian, hamamelis, taraxacum, pyrethrum, psyllium, Datura tatula, fennel and liquorice; that the collection of seaweeds, as a source of iodine, should be undertaken on a large scale. The same official body also recommends that the production of the following drugs should be pursued within the British Empire: agar, bitter orange peel, benzoin, balsam of tolu, calumba, camphor (natural and synthetic), cantharides, mirabilis, cascara sagrada, cinchona, chrysarobin, cocaine, creosote, derris, ephedrine (natural and synthetic), ergot, gentian, liquorice, hamamelis, Hyoscyamus muticus, ipecacuanha, jaborandi, krameria, lobelia, menthol (natural and synthetic), almond oil, star aniseed oil, oil of cade, oil of chenopodium, oil of lemon, oil of peppermint, turpentine and colophony, psyllium seeds, rhubarb (*Rheum rhaponticum*), santonin, squill, storax, thymol (natural and synthetic) and tragacanth.

Mycenæan Origins and Chronology

THE beehive tomb or *tholos* at Mycenæ known as the "Treasury of Atreus" is one of the most important monuments of the Bronze Age in Greece, and the finest example extant of Mycenæan architecture. Its significance in the reconstruction of the course of development of the early civilization of the eastern Mediterranean was further emphasized when Sir Arthur Evans, on the evidence of a beehive tomb then recently discovered in Crete, attributed the Treasury of Atreus to a Minoan derivation, assigning it to an earlier date than that generally accepted and making it the archetype of which other and inferior beehive structures at Mycenæ were degenerating derivatives. This conclusion ran counter in particular to the results of excavations in the dromos, the walled passage approach to the Treasury, carried out by the British School of Archæology at Athens in 1920–23. On general grounds and in view of their numerical distribution, the beehive tombs might well be, it seemed, a product of the Mainland or Mycenæan civilization, while the excavations pointed to a date not later than 1350 B.C. This date harmonized with a logical and natural evolution in architectural development which emerged from study of the three groups of beehive tombs.

With the view of meeting objections to this view raised by Sir Arthur Evans and Prof. J. L. Myres, based in the main upon a hypothetical reconstruction of the dromos, a further examination of the dromos was undertaken in 1939, of which the results have been reviewed by Mr. A. B. Wace in *Antiquity* of September. They would go to show conclusively that the Treasury of Atreus is to be assigned in date not to the close of the Middle Minoan period in the late seventeenth century B.C., the great building period at Knossos, as Sir Arthur Evans argues, but to a date not before 1350 B.C. The evidence is derived from household refuse in a cleft which was cut through by the builders, and in which the pottery fragments and other relics are shown to range in date from 1450 to 1350 B.C. This refuse is of further interest in that it is derived from a group of houses belonging to a well-to-do residential quarter, standing on the ridge above the Treasury. This residential quarter is the first of its kind so far found at Mycenæ outside the citadel walls.

Archæology and Tradition

How far it is justifiable or even permissible to make use of tradition or 'folk-memory' in the interpretation of archæological data and the results of archæological excavation has been the subject of much argument. Some, like Lord Raglan, regard it as almost or completely valueless, while others would concede that in the reconstruction of prehistory, legend and folk-lore may sometimes afford a valuable clue to cultural or racial impact and subsequent changes in style, technique and practice. The question is one of no little importance in the pre- and early history of the British islands, where the traditions and lore of the Celtic-speaking peoples should be a mine of information as yet far from fully explored from this aspect. It is not often, however, that it is possible to bring a tradition to the bar of judgment and decide upon its value so conclusively as have Dr. F. J. North and Mr. W. F. Grimes in "The Legend of Llys Helig—its Origin and Significance" (Supplement to the Proceedings, Llandudno, Colwyn Bay and District Field Club, Llandudno, 1940. Pp. x+67, with 8 pls. Price 5*s*.).

Helig, the story goes, was a king of North Wales who flourished towards the end of the sixth century of our era, though the statements as to his lineage, etc., allow a margin of variation of some centuries in dating. At this period, it is said, an inundation overwhelmed his lands and a considerable portion was irretrievably lost. Llys Helig is the name given to a patch of seaweed-covered stones to be seen when the tide is at its lowest out to sea off Penmaenmawr. It is popularly regarded as the site of Helig's palace; and in 1864 an account of an expedition to view the 'sunken ruins' by Mr. Charlton Hall described them as "a grand old hall of magnificent dimensions". The authors of the present account have made an exhaustive analysis of the literary, historical, geographical, geological and archæological evidence, which points to the conclusion that much of what has been adduced as evidence is inadmissible; and that such valid evidence as there is demonstrates conclusively that the spot where the stones occur could not have been occupied by human beings at any period to which the legend is supposed to relate; while the final verdict of geologist and archæologist is that Llys Helig itself is a heterogeneous and unsorted assemblage of boulders representing the debris of a denuded hillock of boulder clay, and never has been the component part of any building or structure, even such as a weir.

Seals in the Ancient East

SEALS and sealings are so frequently the subject of reference and their importance so often stressed in accounts of archæological investigations in the ancient East which are directed to the interest of a public comprising others than the expert, that any attempt to extend a knowledge of the historical and cultural importance of the subject as well as of the intrinsic merits of the seals themselves is deserving of every encouragement. Dr. Henri Frankfort's excellent work, though by no means heavy reading, is probably too detailed for all but those who have made some headway in the subject. For those whose interest whether in the historical value or the æsthetic merits of the ancient seal has still to be aroused, a recent leaflet of the Field Museum of Natural History, Chicago ("Ancient Seals of the Near East" by Richard A. Martin. Leaflet 34, 1940. Pp. 4, with 24 illustrations and explanatory text. 25 cents) is an excellent provocative.

Twenty-two sealings are illustrated from reproductions in the frieze of the Babylonian Hall of the Museum. They cover some of the finest examples in the major periods in Near Eastern glyptic art from the fourth millennium B.C. (Jemdet Nasr) to the third-fourth century A.D. (Sassanid), when the pictorial stamp seal of the Near East was drawing near its end. Among the more notable examples included are seals of the Agade period when the art reached its highest expression, the Ur-Nammu seal of the twenty-third century B.C. with its remarkably fine type of Babylonian writing, the highly ornamental Hittite seal of the fourteenth century B.C. in which four Gilgamesh figures in a wheel recall the early origin of the swastika, and last but not least for its historical significance the Harappa seal, showing elephant, rhinoceros and crocodile, found in Mesopotamia but unquestionably imported from the Indus Valley. The explanatory text which accompanies each illustration gives such historical and mythological detail as is adequate for understanding of the subject-matter of each seal impression. Technically the illustrations are almost beyond criticism.

Mound Builders' Temple, Ohio.

EXPLORATION of a mound near North Benton, Ohio, has brought to light the remains of a structure identified as a temple in which a number of objects are apparently new to knowledge of the culture of the Mound Builders. The mound was excavated by Mr. Roy Saltman and Mr. Willis H. Magrath. It has been assigned by Mr. Richard I. Morgan, curator of archæology in the Ohio State University, to the Hopewellian phase, the most advanced of the Mound Builder culture, which extended from Ohio down the Mississippi and Tennessee valleys. In an account of the excavation (*Scientific American*, August 1940), it is stated that within a circle of stone slabs there was evidence of an inner wall of wood in the form of charred stumps, which had supported a circular building nearly 70 ft. in diameter. A corridor from a gateway in the west side led to a fireplace in the middle of the temple floor. Stone altars and clay cones flanking the corridor bore charred bones and offerings of stone implements, mica, galena and copper.

The most striking feature of the temple was the figure of an eagle of white sandstone flags on an understructure of moulded clay, which measured 32 ft. across and 16 ft. from head to tail. It was headed towards the rising sun. Overlying the wings were two human skeletons, male and female. Numerous broken fragments of human skull bones and similar fragments on the nearby altar stone suggest

human sacrifice as part of a burial ceremonial. Not only is the eagle figure unique, but also human sacrifice is a new element in finds in other branches of the Hopewellian culture. The culture of the Mound Builders, which developed between the beginning of the Christian era and Columbian times, had disappeared before the arrival of Europeans. The suggested connexion between this culture and that of Mexico and Central America might well account for the appearance of human sacrifice, to which the inhabitants of Mexico were particularly addicted.

Murder by Children and Adolescents

IN his inaugural thesis (*Thèse de Paris*, No. 108; 1940), Dr. Louis Begon, who records seven cases of attempted murder committed by males aged fourteen to nineteen, states that the motives for murder at this age show a much greater variety and are much more complicated than in the case of adults. The medico-psychological examination of cases of murder by young persons is of considerable practical interest both as regards the outlook of the case and the prognosis. The offenders may be classified in three different groups. The first consists of those guilty of a single offence. In such cases the prognosis is good, and a relapse is not likely to occur, provided that a change is made in the environment, which has an important influence on the determination of the act. The second group consists of those in whom murder is the result of disease. In such cases internment is required. The third group is formed by abnormal persons who are not really insane or suitable for detention in an asylum, but are dangerous individuals against whom society should be protected, in the absence of which protection a recurrence will probably happen.

Tuberculosis in Mental Hospitals

IN a paper (*Amer. J. Psychiat.*, **96**, 1335; 1940) based on his experience of pulmonary tuberculosis in mental hospitals during the last nine years, Dr. C. A. Wicks states that though the tuberculosis mortality rate for patients in the Ontario mental hospitals has shown a tendency to decrease since 1934, in 1936 the rate was fourteen times greater than that for the province as a whole. Approximately 2·5 per cent of 2,908 patients admitted to the Ontario mental hospitals during 1938 required isolation on account of X-ray findings in the chest. From the tuberculosis situation as it existed in January 1939 it was estimated that a central tuberculosis mental hospital would be required to accommodate approximately 5·2 per cent of the patients in Ontario mental hospitals. X-ray examination of the chest in 2,542 staff in the Ontario mental hospitals in 1937–38 showed that 0·6 per cent required treatment for tuberculosis. Since 1933, about 0·5 per cent of the employees have needed such treatment every year. About 1·7 per cent of 839 apparently healthy applicants or new staff in the Ontario mental hospital service during the calendar year 1938 showed X-ray evidence of pulmonary tuberculosis which was active or possibly active, thereby rendering them unacceptable for employment.

Public Health and Advertising

IN a paper read before the Health Officers' Section of the American Public Health Association (*Amer. J. Public Health*, **30**, 880; 1940) Dr. K. E. Miller, medical director, U.S. Public Health Service, remarks that unrestrained advertising becomes a matter of public health concern primarily in connexion with those products which either directly or indirectly affect public health, such as foods, drugs and cosmetics. He points out that one of the most potent means for regulating unfair practices and protecting public health interests consists in the control of false and misleading advertisements, especially of those products which may be injurious to health. Apart from changes in the existing laws, State and local health forces can make valuable contributions to the success of the campaign against dangerous nostrums and the advertising of other medicinal products.

Fatal Accidents in the United States

ACCORDING to the *Journal of the American Medical Association* of August 10, p. 470, the United States Bureau of the Census recently published a statistical study of fatal accidents in the six years 1933–1938. In 1933, fatalities from accidents totalled 90,932, and thereafter the number rose to a maximum of 110,052 in 1936. Then it decreased to 93,805 in 1938. Deaths caused by fires, which ranked seventh among all accidental causes during 1933–37, advanced to the sixth place in 1938. Figures for the successive years were 1,521 in 1933, 1,752 in 1934, 1,581 in 1935, 1,913 in 1936, 1,688 in 1937 and 1,650 in 1938. There were more victims from fire in the age group 5–9 than in any other group in 1938; there were 129 deaths in this group, which was 7·8 per cent of all persons burnt to death. The next largest number was in the group 50–54 with 109 deaths. Only 18·3 per cent of deaths from injury by fall occurred among persons less than forty-five years of age, who form 77 per cent of the population, but 55·8 per cent of the motor fatalities and 91·3 per cent of aeroplane fatalities were in this younger group.

Improvement of Grassland

GRASSLAND improvement is the main theme of the July number of the *Scottish Journal of Agriculture* (**23**, No. 1, H.M. Stationery Office. 1*s*., postage extra). Viewing the subject as a whole, a moderately long-term policy for higher farming is advocated, since facilities for improvement are now specially favourable, and stock-carrying capacity must be increased and fertility built up for the future. As a means of maintaining hill grazing as an economic proposition, the introduction of cattle, or a considerable increase in their numbers, is suggested. Bracken control is also dealt with in some detail, and the various machines recently used for this purpose described. With regard to the renovation of old pasture, practical

experience has shown that ploughing is preferable to surface harrowing, and that seed-bed consolidation is essential for success. The suitability of mixtures for re-seeding, and the chemical aspect of grassland improvement are also considered. An article on ensilage and grass drying completes the other side of the picture, the different methods of conserving grass and their relative feeding values being fully described and discussed. Among other subjects of current interest in this number of the *Journal* is a well-illustrated account of a new method of trapping and destroying rabbits on a large scale. The *Journal* is now to be issued half-yearly instead of quarterly.

Vocational Training and Black Rust Control

The classical struggle of the United States Department of Agriculture against the black rust disease (*Puccinia graminis*) of small grains, forms the subject of a leaflet (No. 1, Revised 1939) entitled "Teaching the Control of Black Stem Rust of Small Grains in Vocational Agriculture Classes". This has been prepared by the Vocational Division of the Office of Education, U.S. Department of the Interior. Destruction of common barberry, the alternative host plant of the fungus, still requires to be practised, and a teaching plan for the portrayal of this need is detailed in the leaflet. The life-history of the fungus and its devastating effects are shown by effective diagrams and small photographs, and even the most unimaginative teacher could scarcely fail to thrill a class if he followed the suggestions put forward. Co-operation with the U.S. Department of Agriculture has been closely maintained, with the result that a valuable source of specialist information is provided for the general teacher.

Animal Husbandry in India

The report has just been published of the *Proceedings* of the third meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India (Simla: Gov. India Press, 1940). The meeting was held at New Delhi during February 20–23, 1939, and the variety of the nineteen topics discussed indicates the complexity of India's problems and the research activities which have been stimulated through the influence of the Imperial Council of Agricultural Research. Reference to the *Proceedings* and the discussions recorded there show how valuable to the investigators and agriculturists concerned must be the pooling of information from all the corners of the land which takes place at such meetings and helps to determine the lines upon which particular investigations must be conducted. But we must add that the form in which the *Proceedings* are published leaves much to be desired: there is no index to the subjects or authors mentioned in these 307 pages, and even the list of topics has no page references to guide the inquirer; so that, for example, we find the discussion on the warble-fly on p. 88, and the introductory remarks on which the discussion was based on p. 155, with a title which, as printed, is unintelligible.

Pictorial Illustration for Engineering Draughtsmen

In the drawing office a rigidly conventional system of orthographic projection is employed which tends towards the suppression of ability in pictorial representation. To the draughtsman himself his conventional views are sufficiently expressive and communicative, but occasions arise when greater realism is necessary in order to inform and impress the uninitiated. For guidance in this unaccustomed field, the Association of Engineering and Shipbuilding Draughtsmen has issued a new publication entitled "Freehand Drawing and Pictorial Illustration for Draughtsmen" by W. H. Kerry and E. W. Stott (London: The Draughtsman Publishing Co., Ltd. 2*s.*) which shows how in a number of typical cases pictorial sketches can be prepared. A chapter devoted to "Perspective Construction", on which the subsequent treatment is based, is followed by a statement of the nature and classes of work which the engineering draughtsman may be called upon to treat pictorially, and the purposes for which this method of treatment is necessary; as, for example, the illustrations required by the Patent Office. The main subjects are dealt with under the titles "Treatment of Machine Details", "Conventional Treatment" and "Illustration for Reproduction with an Outline of some of the Printing Processes", and the whole forms a sequence of practical instruction which must prove invaluable to the draughtsman who is unskilled in this unfamiliar field and uninformed regarding the methods to use for different conditions of reproduction.

Properties and Applications of Witherite

In *Engineering* of September 13 there is an interesting article on the properties and applications of witherite (barium carbonate). It is stated in a handbook issued jointly by the Holmside and South Moor Collieries, Ltd., and the South Moor Collieries, and the Settlingstones Mines, Ltd., that witherite is found in economic quantities only in the northern part of England and that the mines producing it supply the world demands for the mineral. The material derives its name from that of Dr. W. Withering, a Birmingham physician and amateur geologist, who in 1784 when examining samples taken from an old lead mine at Alston Moor, on the borders of Cumberland and Northumberland, first recognized the mineral to be chemically distinct from barytes.

Large quantities of witherite are used annually in the preparation of precipitated barium sulphate (permanent white) which is employed in the paper industry for the manufacture of highly glazed coated papers. It is also used in the printing ink and colour industries, in the manufacture of paints and as a filler in the rubber, linoleum and other industries. Among other engineering applications of witherite is the softening of water for boiler feed. It is specially useful when scale-forming and corrosive waters are encountered. Thus sodium and calcium sulphates are converted into the carbonates of these metals, with the precipitation of insoluble barium sulphate. Ground witherite mixed with wood charcoal, usually

in the proportion of 40 per cent of the former and 80 per cent of the latter, has been used for many years as an energizer for carburizing compounds in the case-hardening industry. Considerable proportions of barium oxide, in some cases nearly 50 per cent by weight, enter into the composition of crown and flint optical glasses used for the production of lenses. Finely divided barium carbonate is also claimed to increase the resistance of cement to the action of sulphate-containing waters.

Credit and the Family Budget

THE Office of Education, United States Department of the Interior, has issued a bulletin "Credit Problems of Families" (Vocational Division Bulletin No. 206, Home Economic Series No. 23) to aid teachers of home economics in guiding students in an understanding of the place of credit in family financial management and in the solution of their own credit problems. Credit has played an increasing part in recent years in the financial plans of American families, and this study, which covers both credit for everyday use and long-term uses of credit, is intended to assist the understanding of the principles governing the sound use of credit. Numerous suggestions to teachers are included.

Help for Scientific Research in Canada

THE Canadian Government has announced the appointment of nine members to administer funds presented by patriotic citizens for assisting technical projects and scientific investigations now being undertaken or proposed by the National Research Council with the object of increasing the efficiency of the Canadian war effort. The chairman is Dean C. J. Mackenzie (acting president of the National Research Council), and the members include Sir Frederick Banting, Mr. J. S. Duncan (Deputy Minister for Air), Prof. Maas (head of the Physics Department of McGill University), and Colonel Allen Magee (executive assistant to the Minister of National Defence). Funds given or promised amount to £225,000.

The *Sedov* on a New Expedition

THE Geographical Department of the Northern Sea Route Administration (U.S.S.R.) has sent out the icebreaker *Sedov* on a new expedition to the north-eastern part of the Kara Sea. It will be remembered that the *Sedov* returned to Murmansk on January 29, 1940, after a remarkable drift in the Arctic of twenty-seven months duration. The head of the new expedition is Mr. V. I. Vorobyev. The purpose of the expedition is to study one of the most important parts of the Northern Sea Route in the Kara Sea—from Izvestia Tsik Islands to Russky Island. The total length of this part is about two hundred nautical miles. The expedition is to carry out hydrographic and hydrological research: it will make systematic soundings of the depths of the sea, study the currents, wind regime, ice conditions, and carry out magnetic observations.

Announcements

DR. K. E. BULLEN, lecturer in mathematics at University College, Auckland, New Zealand, known for his work in seismology, has taken up an appointment in the Department of Mathematics of the University of Melbourne.

SIR ARTHUR HURST will deliver the eighteenth Norman Kerr Lecture to the Society for the Study of Inebriety on October 8 at 4 p.m. in the Friends House, Euston Road. His subject will be "Alcohol and the Organs of Digestion".

IN consequence of the War, it has been decided to postpone, for the present, the Chadwick Public Lectures which were to have been delivered this autumn.

THE following are serving as officers of the Society of Chemical Industry for 1940–41: *President*, Prof. J. C. Philip; *Honorary Treasurer*, Dr. L. H. Lampitt; *Honorary Foreign (or Overseas) Secretary*, Dr. Wm. Cullen; *Chairman, Bureau of Chemical Abstracts*, Dr. L. H. Lampitt; *General Secretary*, H. J. Pooley, Clifton House, Euston Road, London, N.W.1.

THE average mortality rate from all causes in the large cities of the United States for the four weeks ended June 15, based on data received from the Bureau of the Census, was 10·9 per thousand inhabitants. The average rate for this period in the five preceding years was 11·0.

THE Medical Research Council has received four motor-vehicles specially equipped for medical work from the United States. These were originally purchased by the American Quakers and the International Commission for the Assistance of Child Refugees for use in France. The vehicles now are to be used principally in the work of the Emergency Blood Supply depots in the neighbourhood of London.

DR. F. HOYLE, St. John's College, Cambridge, writes: "I have noticed an error in a letter by Lyttleton and myself on 'The Evolution of the Stars' appearing in NATURE of July 20, p. 97. The sentence 'Thus the effect of collisions is to excite the vibrational and rotational levels of the $^3\Sigma$ state of the molecules, and this internal energy can be radiated by quadrupole transitions to the ground state of the molecules', should read: 'Thus the effect of collisions is to excite the vibrational and rotational levels of the $1^1\Sigma$ state of the molecules, and this energy can be radiated by quadrupole transitions as an infra-red spectrum'."

ERRATUM. In the obituary of Prof. A. E. H. Love in NATURE of September 21, p. 393, three lines from foot of second column, for "Anthony Berry" read "Arthur Berry".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Origins of Electric Transmission by Resonance

THE death of Sir Oliver Lodge, full of years and honour, recalls brief episodes in the early development of wireless telegraphy. One remembers Lodge describing how he and his assistant at Liverpool were experimenting with a Hertzian spark vibrator: another such vibrator, a duplicate of it, happened to be at the distant end of a long lecture bench, and they noticed an extraordinary development of receptive sparking in it. With the simplicity of genius Lodge recognized that this was due to resonance, for the period of vibration in the receiver must be the same as that of the identical transmitter. One result was a master patent, which was for long a thorn in the side of practical adventurers. (The Bell telephone happens to be another instance of reciprocity of emitter and receiver.)

One may ask, did Hertz in his classical experiments on wave-lengths take this very striking role of Fourier resonance into his chain of ideas ? (FitzGerald had remarked on it five years earlier.) His broken ring receiver would probably have had to be inconveniently large to bring it into resonant relation. One seems to remember that it gradually occurred to informed minds that the vagaries of reception were due to the disturbance selected by the receiver being largely a Fourier component of its own wave-length, as that one was intensified by resonance, so that the wave-length observed would be that of the receiver, not the emitter ; a principle now of utility in the other direction to prevent sympathetic leakage into adjacent systems.

During a lecture by Lodge at the Royal Institution, a vibrator on the table was observed to excite sparks on the gold-patterned paper on the walls : but these were perhaps more likely ordinary electrodynamic effects due to completion across a gap of metallic circuits. The converse case was D. E. Hughes's much earlier uninstructed detection of electric waves at the appropriate much greater distance, from which he was dissuaded by the conservative frame of mind of Stokes, strikingly effective also on the mentality of his disciple Lord Kelvin, though he was himself the detector of fluorescence.

In the well-known contemporary account of Hertz's discovery by G. F. FitzGerald of Trinity College, Dublin, which now happens to be accessible here in his Collected Papers, I find, however, some reference to tuning of the receiver. One remembers, by the way, the excitement then produced in Dublin by the direct reception of the news of a regatta in the Bay from Marconi who was a guest on the flagship. FitzGerald was a close friend and indeed instructor of Lodge, who after his premature death became a life-long apostle. The wave properties of electric transmission on analogy with those of light were closely pursued in his few later years in FitzGerald's laboratory, which then included the present Provost of that illustrious College.

These considerations are largely out of date in practice, but though simple they are far from obsolete in theory, which should avoid abstruseness.

JOSEPH LARMOR.

Holywood,
N. Ireland.
August 23.

Structure of Liquid Argon

MOST of the X-ray investigations of liquids have led to a distribution function which cannot be compared directly to the corresponding distribution of atoms in the solid since one peak in the liquid distribution function usually corresponds to several peaks in the distribution function of the solid. For this reason we investigated several years ago the structure of molten salts such as potassium chloride and lithium chloride where one can assign to each peak in the liquid distribution function one peak in the distribution function of the solid. We have shown that the co-ordination in the liquid and the solid is the same ; number of first neighbours N_1 in the solid equals 6 and in the liquid 5·8. The number of second neighbours N_2 in the liquid (K–K or Cl–Cl) is already greatly disturbed ; in the solid there are 12 and in the liquid 9·8.

Since the development in recent years of a more refined theory of liquids[1] has permitted the prediction of the number and position of nearest neighbours in a normal liquid, it was of particular interest to study the structure of liquid argon.

Because liquid argon at atmospheric pressure is only stable over a temperature range of 3·5° (boiling

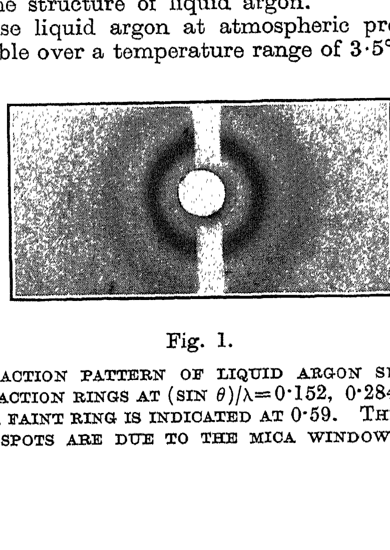

Fig. 1.

DIFFRACTION PATTERN OF LIQUID ARGON SHOWING DIFFRACTION RINGS AT $(\sin\theta)/\lambda = 0{\cdot}152$, $0{\cdot}284$, $0{\cdot}410$ AND A FAINT RING IS INDICATED AT $0{\cdot}59$. THE LAUE SPOTS ARE DUE TO THE MICA WINDOWS.

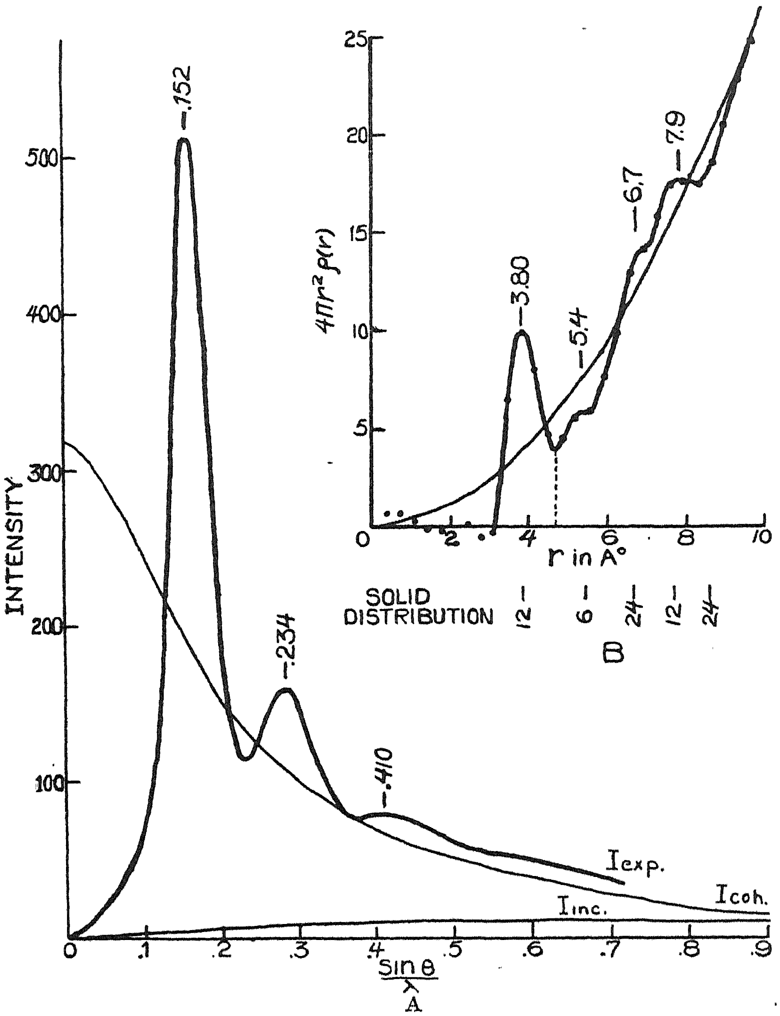

Fig. 2.

Iexp. (A) shows the microphotometer trace of the diffraction pattern reduced to intensity and corrected for absorption and polarization. Peaks at $\sin \theta/\lambda = 0{\cdot}152$, $0{\cdot}284$, $0{\cdot}410$, a faint indication of a peak at $0{\cdot}59$. B shows the distribution function of the liquid and as a comparison the distribution in the solid is listed below the abscissa.

point $-185{\cdot}7°$ C. and melting point $-189{\cdot}2°$ C.) a special container for the liquid was constructed which made it possible to apply pressures slightly above atmospheric pressure during the exposure.

Pure gaseous argon is introduced into the cell and is there condensed under a pressure of 910 mm. mercury and at a temperature of $89{\cdot}2°$ K. The liquid argon is held in a layer of about $1{\cdot}3$ mm. thickness between two mica windows, $0{\cdot}01$ mm. thick. The mica windows are sealed with indium gaskets to the copper walls of the cell proper which is cooled by a continuous stream of liquid air. This arrangement permits making a definite absorption correction (plane parallel layer) for the intensity measurements of the diffracted X-rays, and the diffraction pattern of the cell walls does not interfere with the liquid pattern itself. The absorption and the scattering of the cell walls are small compared to the corresponding values for the liquid. Monochromatic silver $K\alpha$ radiation reflected from a rock salt crystal was used in a vacuum camera, thus eliminating air scattering and continuous background.

The diffraction pattern, recorded photographically, shows three distinctly visible rings and a fourth ring is revealed upon closer inspection (Fig. 1).

Fig. 2 shows the experimentally observed intensity ($I_{\text{exp.}}$) properly corrected together with the coherent ($I_{\text{coh.}}$) and incoherent ($I_{\text{inc.}}$) scattering to be expected theoretically matched at $(\sin \theta)/\lambda$ of about $0{\cdot}7$ for quantitative analysis.

From a Fourier analysis the atomic distribution curve in the liquid has been obtained and is shown in Fig. 2 B. The first neighbours are to be found at $3{\cdot}8$ A. ($3{\cdot}82$ A. in the solid). The area under this peak gives the number of the first neighbours. From the various patterns which we have obtained this number was determined as $9{\cdot}6$, $10{\cdot}1$ and $10{\cdot}3$ nearest neighbours[2]. Further concentrations corresponding to the outer neighbours occur at $5{\cdot}4$, $6{\cdot}7$ and $7{\cdot}9$ A. The number of neighbours and their distances, as they occur in the solid (Fig. 2 B), indicate how far the liquid structure retains the arrangement found in the solid.

The results show that the type of co-ordination, as found in the solid, is retained in the liquid, but the transition solid-liquid in argon produces a disorder already pronounced in the reduction of number of first neighbours, as compared to $N_1 = 12$ in the solid.

Theoretical investigations[3] indicate that such a reduction in N_1 is necessary to account for the thermodynamical data. Recent investigations by O. K. Rice[3] lead to 10–$10{\cdot}5$ nearest neighbours for argon in the temperature range of our experiments, in good agreement with the results obtained.

The substance of this work was reported at the Pittsburgh meeting of the American Physical Society during June 20-22, 1940.

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E. P. Miller.

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August 20.

[1] Fowler, R. H., and Guggenheim, E. A., "Statistical Thermodynamics", § 808, and following.

[2] Eisenstein, A., and Gingrich, N. S. (*Bull. Amer. Phys. Soc.*, **15**, No. 2; April 1940) in a preliminary report give 7 atoms at $3{\cdot}9$ A. as nearest neighbours. This result, which seems rather difficult to reconcile with the theoretical predictions, was obtained with an experimental arrangement different from ours and in a different p-T range. It might be pointed out that at higher molal volume the curves of Rice[3] indicate a possible change in co-ordination, but scarcely so low as the preliminary results of these authors indicate.

[3] Fowler and Guggenheim, *loc. cit.*, and Rice, O. K., *J. Chem. Phys.*, **7**, 136 and 883 (1939).

Resonance in the Chloracetic Acids

In a letter in Nature, H. O. Jenkins[1] has discussed the dissociation constants of the chloracetic acids, and concluded that the electrostatic inductive effect cannot account for the strength of the di- and trichloracids, although that of the mono-acid is quantitatively explicable on this basis[2], since "no functional relationship can be traced between μ_R (resultant moment of the C-Cl links) and K (dissociation constant)". This conclusion is, however, incorrect; for, if the bonds are tetrahedrally arranged around their carbon atom, the change in the electrostatic potential ψ ($= \mu\cos\theta/r^2$) at the carboxyl group (which is the inductive effect), should be proportional to the number of C-Cl links present, if μ, θ and r remain unchained for each link. That is, we should have

$$pK = pK_0 - qx, \qquad (1)$$

where pK is the negative logarithm of K, for x chlorine atoms, pK_0 that of acetic acid, and q a constant; that is, the Ostwald-Wegscheider rule, although the resultant moments of the corresponding chlormethanes are not as 1 : 2 : 3.

The results given below show that the factor q decreases with x; hence the di- and tri-acids are weaker than they should be on this simple hypothesis, while Jenkins represents them as abnormally strong. This diminution in q can easily be explained. Smyth and McAlpine[3,4] pointed out that the dipole moments of the C-Cl links in CH_2Cl_2 are less than that of this link in CH_3Cl because of the mutual effect of the dipoles, and that this effect would probably be linear in the number of C-Cl links present. Hence we might expect

$$pK = pK_0 - sx + t\,(x - 1). \qquad (2)$$

The available data on these acids are given in the accompanying table ($pK_r = pK - pK_0$):

	pK			pK_r		
	H_2O	MeOH	EtOH	H_2O	MeOH	EtOH
CH_3COOH	4·757[5]	9·762[7]	10·44[7]	0	0	0
$CH_2ClCOOH$	2·861[6]	7·838[7]	8·51[7]	−1·90	−1·92	−1·93
$CHCl_2COOH$	1·30*	—	6·89[7]	−3·46	—	−3·55
CCl_3COOH	—	4·92[8]	—	—	−4·84	—

* Ostwald's value.

The alcohol values must be considered since no accurate value for trichloracetic acid in water is available. As mean values for pK_r, therefore, we have −1·92, −3·50, −4·84. The equation (2) given, with $s = -1{\cdot}92$, $t = 0{\cdot}30$ predicts (−1·92) −3·52, −4·82 within the experimental error.

Further, since t is related to the bond-polarizability, for the fluor-acids it should be smaller, for the bromo- and iodo-acids larger, than for the chloracids. The only extant data are for propionic, α-brompropionic, and αα-dibrompropionic acids[9]: pK 4·87, 2·97, 1·48[9]. If equation (2) is valid, $s = -1{\cdot}90$, $t = 0{\cdot}41$ as compared with 0·30—in the right direction. It is suggestive that Wegscheider[10] found the largest deviation from equation (1) for substituted benzoic acids if the groups were 1 : 2 : 3, or 1 : 2 : 6 (carboxyl at 1), when the mutual interference must be a maximum. Exact calculation of the t term is not at present possible, but the order is reasonable[3,4].

Although explanations in terms of resonance and polarizability are not fundamentally opposed, Jenkins' relations between pK and n are of doubtful significance; resonance energy is not, in general, linear in the number of canonical forms. Finally, the resonance possibilities of the undissociated acids are very similar to those of their anions.

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[1] Jenkins, Nature, **145**, 625 (1940).
[2] Kirkwood and Westheimer, *J. Chem. Phys.*, **6**, 506, 513 (1938).
[3] Smyth, C. P., and McAlpine, *J. Chem. Phys.*, **1**, 190 (1933).
[4] Compare also Sutton and Brockway, *J. Amer. Chem. Soc.*, **57**, 473 (1935).
[5] Harned and Ehlers, *J. Amer. Chem. Soc.*, **55**, 652 (1933).
[6] Wright, *J. Amer. Chem. Soc.*, **56**, 314 (1934).
[7] Minnick and Kilpatrick, *J. Phys. Chem.*, **43**, 259 (1939).
[8] Goldschmidt, H., and Aarflot, *Z. Phys. Chem.*, **117**, 312 (1925).
[9] Walden, *Z. phys. Chem.*, **10**, 650 (1892).
[10] Wegscheider, *Monat. Chem.*, **23**, 288 (1902).

Nature of the Cyanide-stable Portion of Cellular Respiration

In a recent and interesting review by Commoner[1], on the cyanide inhibition of cellular respiration, it is suggested that the cyanide-stable respiration is mediated through the yellow-enzyme system and is concerned with the oxidation of fatty substances, that is, compounds with a low O/C ratio. As tentative support for this hypothesis Commoner instances the relatively high Q_O^{CN} of liver, kidney and heart, the high flavin content of these tissues, and their low respiratory quotient (*R.Q.*) values.

Unfortunately, in advancing these ideas, no account has been taken of the possible contribution of purine oxidation to the cyanide-stable respiration. In the case of ox-liver it may be shown that such oxidation possibly accounts for the whole of this cyanide-stable respiration. From previous data of mine[2] the Q_{O_2} of 'minced' ox-liver may be calculated to be 1·8, of which the greater part was shown to be due to purine-base oxidation, and which is only slightly inhibited by cyanide. This value for Q_O^{CN} agrees quite well with that of 1·5–2·4 deduced by Commoner. For ox-liver, where uricase activity is absent, the *R.Q.* for purine-base oxidation is nil, so that if such oxidations account for any great part of the total respiration, the *R.Q.* value for the whole tissue will be much lower than unity. The low *R.Q.* values for liver do not therefore necessarily prove that fat oxidation is predominant. The high flavin-content of these tissues may also be accounted for by its xanthine oxidase activity in view of the identification of this enzyme as a flavin.

The evidence quoted in favour of Commoner's hypothesis is thus equally in favour of the view that the cyanide-stable respiration in mammalian tissues is to be identified with purine-base oxidation.

It is worth while pointing out that, with some plant tissues, notably those of carrot leaf and tea leaf, considerably higher concentrations of cyanide (*m.*/100) are required to bring about maximum inhibition of respiration. I have also recently shown that *m.*/100 cyanide is necessary for full inhibition of oxidation of catechols and *p*-phenylenediamine by a preparation of tea oxidase believed to be a cytochrome oxidase.

If, as seems likely, a cytochrome system is operating in these tissues the cyanide sensitivity of cytochrome must vary considerably according to the nature of the tissue. Until this variation has been properly

investigated it seems premature to speculate upon the nature of the cyanide-stable portion of respiration as we may have here a case of incomplete inhibition of cytochrome oxidation by cyanide. There is also the possibility that in one tissue there may exist more than one cytochrome oxidase, varying in sensitivity towards cyanide.

Further details as to the cyanide sensitivity of the tea oxidase and its similarities to cytochrome oxidase will be published elsewhere.

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June 21.

[1] Commoner, B., *Biol. Rev.*, 15, 168 (1940).
[2] Roberts, E. A. H., *Biochem. J.*, 30, 2166 (1936).

Faunistics and Ages of the East African Islands

On an ordinary map the three low tropical islands of Pemba, Zanzibar and Mafia appear to bear a similar relationship to the African continent, from which they are all distant less than thirty miles. In fact, however, while the last two islands are on the continental shelf, Pemba is surrounded by water 2,500 ft. deep. Geological opinion is unanimous that Zanzibar and Mafia have been separated from the mainland only since Pleistocene times, but the geological history of Pemba is more uncertain. It has been maintained by Stockley[1,2] that this island has not been connected with Africa at least since Miocene times and his views have obtained wide currency. Actually the geological evidence on which this view is based is not very conclusive; for it is limited to the apparent non-existence of an unconformity between the (non-fossiliferous) Weto beds and the Chakechake beds which are dated as early Miocene.

Recently with the help of the British Museum (Natural History) we have examined the existing check-lists of the island vertebrates[3]. We find that many species have been admitted on inadequate or mistaken evidence while, on the other hand, many have to be added as a result of recent years collecting. We have analysed the revised check-lists and considered the results in conjunction with the fact that: (*a*) evergreen forest, probably the predominant formation in the islands in the past, has been greatly reduced in all of them, (*b*) owing to the topography and the currents the chances of Pemba's being colonized from the mainland (or another island) are, under present conditions, much smaller than those of the other islands. We find that the island faunas are all much poorer than that of the comparable strip on the mainland coast, with important families unaccountably absent, especially in Pemba. In specific composition the island faunas are entirely East African, except for certain Mascarene affinities, most of which appear in Pemba although there is none in Zanzibar. These peculiarities of Pemba are, however, contrary to expectation, exhibited almost entirely by flying animals, which tends to reduce their zoo-geographical significance. The most striking feature of the faunas is that endemism is low in all three islands and in all the vertebrate classes it is mostly subspecific and it is in no case generic. In addition to the single-island endemic subspecies there are several that are confined to Pemba + Zanzibar or Zanzibar + Mafia.

The faunistic evidence is thus in entire accord with the view that Zanzibar and Mafia are Pleistocene islands, and on the whole is strongly against the view that Pemba has been isolated since the Miocene or indeed much longer than the other islands. This conclusion would support the view[4] that the submarine scarps of Pemba may be connected with the extensive Pleistocene rifting in East Africa.

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R. H. W. Pakenham.

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Tanganyika Territory.
July 9.

[1] Stockley, G. M., "Report on the Geology of the Zanzibar Protectorate", Zanzibar (1928).
[2] Stockley, G. M., *Tanganyika Notes Rec.*, 3, 82–86 (1937).
[3] Voeltzkow, A., "Reise in Ost-Afrika in den Jahren 1903–1905". Abt. 1, Stuttgart (1923).
[4] von Staff, H., "Wiss. Ergeb. Tendaguru-Expedition 1909–1912", Berlin (1914).

Camouflage in War-time

In Nature of August 3, p. 168, Mr. C. H. Rowe, criticizing schemes of camouflage painting in Great Britain, made a suggestion, based apparently on hearsay only, which implied that the interests of the Paint Manufacturers' Association was partly responsible for what he considered to be unscientific camouflage.

For the information of readers of Nature, I must explain that the National Paint Federation is not consulted, and has no influence, on the selection of the shades of colours used or the camouflage scheme decided upon, and, moreover, has been instructed that it is not to act in an advisory capacity on such matters. Its duty is to provide paint to the shade of colour selected by, and made to a specification approved by, the Government Department concerned.

We cannot, therefore, accept credit for the excellence of many of the schemes that have been carried out in Great Britain, or blame for any failures.

S. K. Thornley.

National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom,
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I hasten to apologize to Mr. S. K. Thornley and to readers of Nature for the statement made in my letter. The fact that I made clear that my information was entirely hearsay, and that it was from a source which I have had, hitherto, no reason to consider unreliable, does not absolve me. I should, of course, have consulted the Paint Federation first.

Mr. Thornley's prompt denial of responsibility is very welcome, but perhaps he will go further and tell us who it is that approves the specifications for the shades of colour and the paint for Army camouflage ordered from his members. If he can do this, we may be one step further in tracking down the monster of khaki and green 'kidneys' to his lair.

C. H. Rowe.

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RESEARCH ITEMS

Roman Policy in Northern Britain

The extent to which recent archæological excavation demonstrates the development of policy in Roman Britain and the underlying causes, upon which recorded history is supplemented, is indicated by I. A. Richmond in *Antiquity* of September 1940. The political character of northern Britain in the period is determined by two closely related factors—forest and fell—which gave cover to enemies and prevented the growth of flourishing agricultural communities capable of developing social instincts receptive of civilization. From A.D. 43–69 the Romans depended upon alliance with the independent Brigantes centring in West Yorkshire. The problem of controlling the north did not arise until the alliance was broken by the Brigantes themselves. York was then occupied, permanent advance posts established, and Rome committed to the policy of Highland conquest which culminated in the conquest by Agricola of the country south of the Caledonian Highlands and the building up of an elaborate network of roads and a system of forts manned by auxiliaries acting as a police force. The reduction in the legionary forces weakened this system until A.D. 122 when the frontier was withdrawn and Hadrian's Wall was built, at first in turf and then in stone. This produced, however, a stalemate which led to a reversion to the policy of annexing southern Scotland. A turf wall was built by Antoninus between Forth and Clyde, with outposts beyond, controlling routes to the Highlands. The resulting tranquillity allowed the growth of prosperity and orderly life among the Brigantes. At the close of the second century Roman imperial politics drained Britain of troops. This led to tribal incursions from Caledonia and disasters lasting for ten years until order was restored by Severus in a peace which endured for a hundred years, and brought with it a change in outlook. Local recruitment for the auxiliaries converted them from a dominating to a territorial force, while the border tribes became Roman protectorates. The tribe was merging into the nation. The final stage came when the Picts broke through the Wall; and after their devastations had been checked, Rome delegated the north to a strong local administration in which the Brigantes enjoyed an Indian summer of prosperity, and communal instincts were fostered by a steady inculcation of responsibility.

Pre-Portuguese Bronze Castings from Benin

At the time of the conquest of Benin and for some time after, it was assumed that the Beni had learned their bronze casting from the Portuguese. This is not justified by a comparison with contemporary Portuguese technique. From about A.D. 1150 until A.D. 1280 all bronze and brass work at the court of Benin was made at Ife, but eventually Oba Oguolu sent to Ife for a worker to establish bronze and brass work in his country. Ighe-igha was selected to go to Benin. Not only was he a great artist but he was also a great teacher; and at his death he was deified and to this day he is worshipped by the brass smiths at Idunmwu Igun Eroumwo, the quarter of the royal brass founders. Three examples of early bronze casting have been described by Eva L. R. Meyerowitz (*Man* of September 1940). They are in the possession of the Oba of Benin and were excavated in recent years when additions were being made to the royal palace which stands on the ancient cemetery. Of these the first is a badge of office of a priest of Olokun. These badges in older days were housed in a shrine dedicated to the god Olokun in Benin and carried by the priests on ceremonial occasions. The badge is a large bronze casting in semicircular shape showing Olokun, god of the waters, supported by two attendants, a characteristic theme in Benin art. The Obas identified themselves with Olokun, but their representations are to be distinguished from those of the god by the fact that their feet are human while the limbs of the deity usually branch out into catfish. For stylistic and other reasons this specimen is assigned in date to A.D. 1350–1450. The second example is a badge of the Shango priests, a large bronze casting of semi-circular shape with a ram's head. It probably belongs to the same period. The third casting is a triple dagger surmounted by three heads, representing Olokun on the left, Elusu with a fish body in the middle and Olokun's second wife on the right. Elusu, a sea-goddess, is mainly worshipped at the coast around Lagos, and it may be that this dagger did not originate in Benin.

Antihormones

The term hormone is widely known to the layman as is the fact that these substances can be used in the treatment of certain disturbances of the endocrine system, but what is not so generally realized is that animals can also produce neutralizing substances to which the name antihormones has been applied. J. B. Collip, H. Selye and D. L. Thomson have furnished a very useful survey of what is known of these substances (*Biol. Rev.*, 1940), particularly the antigonadotrophic and antithyrotrophic hormones, since these have been the subjects of the most intensive researches. The authors emphasize that it has been definitely established that "pretreatment with certain hormones will cause the appearance in the blood of principles antagonistic to these hormones". The presence of neither the primary organ itself, that is, the gonad or the thyroid gland nor of the hypophysis is necessary to the production of these substances. Whether they are antihormones or antibodies as some authorities claim is difficult to determine, and in any event is perhaps largely a question of definition, but they are definitely specific in their action. In addition to the main antihormones of these two groups which are fully dealt with, the possible existence of a number of others is considered.

A New Bird from Virginia and its Fate

The first new species of bird to be discovered in the continental United States in twenty-one years has just been found in West Virginia by Karl W. Haller, according to the Smithsonian Institution news service. The new species, *Dendroica potomac*, resembles the yellow-throated warbler in colouring, but its song is like that of the parula warbler. It is

odd that a fairly conspicuous bird, not particularly shy in its habits or habitats, should have remained unrecognized for many generations, but it may have escaped notice because of its resemblance to other warblers. There is the other possibility that this new species may be that rarely observed new creation, a fertile cross between two species. The species is founded on two specimens. Mr. Haller was attracted first by the song of a male bird, which he shot. "The real significance of the find came when another bird was shot . . . a female almost identical with the male, and unquestionably fertile. She would soon have laid eggs if not collected." So for all we know, possibly one of Nature's rare achievements, a fertile cross, may have been exterminated even before it was described. But at any rate it is represented by a name in scientific nomenclature, a description, and two skins in a museum.

Reactions of Miracidia of Sheep Liver-fluke

IN the course of experiments testing some reactions of the ova and miracidia of *Fasciola hepatica*, Henry J. Griffiths exposed many representatives of eleven species of Canadian molluscs to miracidia (*Canadian J. Research*, 17, 205; 1939). Individual molluscs were exposed and kept under observation during exposure, being killed later and examined for stages of the parasite. These examinations as well as attempted mass infections in 25 tanks of snails yielded no evidence that any of the species harboured the liver-fluke. Yet on exposure to miracidia all the species were attacked, those belonging to non-Lymnæa groups almost as readily as the Lymnæa types themselves; but the parasite, which attached itself to any exposed portion and might remain attached for 10 minutes endeavouring to penetrate the host's tissue, ultimately dropped off. Although the attacks were deliberate in many cases, in others they were accidental, and miracidia were often seen swimming close to the snails, and even to a known vector *Gyraulus ferruginea*, without showing any sign of attraction or of attempt at attachment. This is in agreement with the conclusions of Mathes, that although miracidia avoid hard bodies such as stones, they show no sign of chemotaxis in finding the intermediate host.

The Eriophyidæ or 'Gall-Mites'

DR. KEIFER's "Eriophyid Studies" (Pts. 1–9; *Bull. Dept. Agric.*, Sacramento, Calif., U.S.A., 1938–1940) constitute one of the most important contributions to this subject published, even surpassing those of the great Viennese zoologist, Dr. Alfred Nalepa. He describes numerous new genera and more than one hundred new species. Those who may have overlooked these valuable and very well illustrated papers, containing 139 plates of more than 1,000 figures, will be pleased to learn that Dr. Keifer proposes at a later date to republish these "Studies" as an "organized whole". Dr. Keifer regards the term 'gall-mites' "a misnomer for the group, as less than 10% of the species cause plant deformations".

Cytological Studies of Salix Hybrids

A. HÅKANSSON (*Hereditas*, 24, 1–31; 1940) has published the results of his cytological studies of hybrids between species of Salix which were made by Heribert-Nilsson. Among the hybrids were two which arose from crossing eight different species of Salix together. These two shrubs were tetraploid and had a regular meiosis. Some other hybrids involving several diploid species were diploid and showed a regular meiosis. In the F_2 of the cross *S. viminalis* × *S. caprea*, both of which are diploid, there was a shrub with a similar morphology and cytology to the tetraploid species *S. cinerea*. Even the cross *S. viminalis* × *S. phylicifolia*, a cross between a hexaploid and a diploid species, produced a tetraploid plant which had a regular meiosis.

Structure and Formation of Antibodies

A PAPER propounding a theory of the structure and process of formation of antibodies was read by Linus Pauling before the annual meeting of the U.S. Academy of Sciences held during April 22–23. This is based on structural information about simpler molecules, and is considerably more detailed than any earlier theory. The theory accounts for many facts, such as the observed antibody-antigen ratios in precipitates, the inhomogeneity of antibodies to a given antigen, and the independence of action of antigens in an immunizing mixture. Among the predictions based on the theory are the following: that the denaturation of antibodies is irreversible; that different antibodies on denaturation and attempted denaturation become identical; that decrease in specificity of the antibody and decrease in antigenic power (amount of antibody produced) accompany increase in number of strong groups in the antigen; that a non-protein and non-polysaccharide substance may have antigenic power if it contains suitable groups and its molecules or particles are sufficiently large; that the synthesis of antibodies *in vitro* might be achieved by denaturing serum globulin and removing the denaturing agent in the presence of an antigen or haptene.

The Probability Concept

THE probability concept was considered in a paper read before the annual meeting of the U.S. National Academy of Sciences (April 22–23) by E. C. Kemble. The long-standing controversy over the nature of probability may be resolved by the type of operational analysis so fruitful in physics. Probability is related to our subjective sense of expectancy in much the same way that a thermometer reading is related to our subjective sense of heat and cold. Probability can be defined as a number derived by standardized mental operations from a definite state of information. In so far as it is dependent on information it is subjective. In so far as the evaluation of probabilities from given data is standardized in a manner acceptable to many persons the concept becomes objective. There is no *a priori* necessity for a *single* rule for evaluating probabilities from all states of information, and one must admit that where the information is vague *no* calculation of an acceptable probability is possible. Evaluation of probabilities on the basis of a principle of indifference is appropriate to one type of informational situation, whereas calculation from relative frequencies in a collective is appropriate to another. There is use for both types of probability in practical and scientific matters. Either one can be used with the standard calculus of secondary probabilities from primary probabilities. However, there is a sharp distinction between the totality of implications which can be drawn from the two corresponding states of information. Failure to observe this distinction is a common and serious error in probability calculations.

EASTER ISLAND ORIGINS*

A FRANCO-BELGIAN expedition, initiated by the Institut d'Ethnologie and the Muséum national d'Histoire naturelle of Paris and supported by the Government and scientific institutions of Belgium, was engaged during 1934–35 in the investigation of the archæology and ethnology of Easter Island. The members of the expedition were Alfred Métraux, Charles Louis Watelin (archæologist), Dr. Henri Levachery of the Musées Royaux d'Art et d'Histoire, and Dr. Israel Drapkin, of Chile. Owing to the death of M. Watelin on the outward voyage, the work of archæological investigation fell to Dr. Levachery, and will be the subject of separate treatment.

In few places in the Pacific does so little remain of the ancient culture as in Easter Island. The present population of 456 natives is entirely derived from the 111 natives left after the abandonment of the island by the French missionaries in 1872. There is thus little chance for the preservation of old traditions. One living person alone survives who witnessed the functioning of the old culture; and she is now more than one hundred years old and of uncertain memory. The principal repository of tradition is the oldest man on the island, who provided the Routledges with their information and is now sixty years of age.

On the racial character of the Easter Islanders two divergent views, based on the evidence of cranial material, are held. Of these, one, while recognizing a Polynesian connexion, seeks to tie up the Easter Islanders with Melanesians or Australians. The second denies the validity of a relationship with non-Polynesian groups, but fails to confirm their Polynesian origin. Dr. I. Shapiro, after a brief review of the evidence, here inclines to the conclusion, based on the evidence of his own measurements of the living, that the Easter Islanders are "definitely Polynesians of a somewhat specialized and exaggerated type, isolated by migration and intensified by inbreeding". Blood-groupings, not yet published, confirm the relationship with Polynesia rather than Melanesia. It is noted that the grammar of the Easter Island language is typically Polynesian and presents no striking individuality.

According to native tradition Easter Island was peopled by Hotu-Matua, who came with two canoes from the west and had been a king in Marae-renga. He was not indeed the first man to land on the island for six other men had preceded him. To Hotu-Matua is attributed the introduction of cultivated plants and all land animals known to the natives, though many of both were demonstrably introduced by Europeans. Among other culture elements assigned to the origination of this hero are the signs of the famous Easter Island tablets. It is considered probable that before the coming of the Europeans there is no reference to Easter Island in the traditions of other islands of Polynesia.

Had Easter Island kingly traditions similar to those of other parts of Polynesia, most of its mysteries might be solved. They do not, however, exist; and the results of the investigations that have been made have produced only lists of kings, arbitrarily formal and with only uncertain and conjectoral geneological sequences.

Next to the stone statues the most famous products of Easter Island art are the wooden images representing emaciated or decaying human beings. Although of ancient origin, the more exaggerated and grotesque have been manufactured to suit the tastes of visitors. The carving of these figures is the only regular industry of the island. The bird-man images—the bird-man is one of the most frequently represented figures in the petroglyphs—demonstrate the extent to which conventional motifs were imposed upon all Easter Island wood carving. Like the stone images, the wooden figures are enigmas and their true significance was not even clear to the natives fifty years ago. They were kept in the houses, and were in the nature of secondary deities. There are natives who still conceive that they are identical with spirits of the dead. Such wooden images of humans are common to the cultures of eastern and central Polynesia, but the emaciated condition of the Easter Island images is foreign to other Polynesian art, except that of Chatham Island.

One object of the expedition was to record all the petroglyphs which could be discovered. In all, 300 were noted. At Orongo, where petroglyphs were first recorded and studied, the bird-man, with the head of a frigate-bird on a crouching human body, is represented in most of the petroglyphs. Only here are the drawings in high relief. Elsewhere they are pecked, and most of the designs represent sea animals. The most spectacular group is near Hanga-o-bonu. It is composed of intermingled motifs which include boats. Human figures are rare. The style of the designs resembles that of the signs on the wooden tablets.

The funerary cairns or *ahus* are the most common monuments in the island, and give it most of its individuality. Probably they correspond to the *maraes*, or sanctuaries of central Polynesia. There are four types, but all are essentially mounds of stones. The large image *ahus*, in which a retaining wall has developed from the heap of stones, are the masterpieces of Easter Island architecture. These structures have numerous affinities with religious structures in other parts of Polynesia.

Cut stones are used extensively on Easter Island. In three other regions only in Polynesia—the Marquesas, the Society Islands, and Tonga—was stone cutting well developed. The excellence of Easter Island stone cutting is due to the use of hard vesicular basalt. It shows an elaborate technique.

The quarry of the giant statues on Rano-raraku crater is one of the most spectacular places in the island, and the fame of Easter Island rests largely upon it. From here come almost all the statues or *ahus*. The quarry on the western slope contains a helter-skelter of unfinished statues, of niches from which finished statues have been removed, and of statues in process of removal. There are 157 statues in different stages of completion. It is possible, owing to their great size, that some were never intended for removal. The images of Rano-raraku which stand below the crater, sixty in all, are not only

* Ethnology of Easter Island. By Alfred Métraux. Honolulu, Hawaii. Bernice P. Bishop Museum. Bull. 160. Pp. vii + 432 + 7 pls.

the largest, but also they alone, among all the giant statues of Easter Island, have not been pulled down. Small stone images are scarce, and differ widely in style from the statues; but they are probably ancient. The heads of many of the statues once bore a big cylinder made of red vesicular tuff as a head-dress. These range from 1·2 m. to 2 m. in height, and from 1·6 m. to 2·7 m. in diameter. Some had a knob or boss at the top. A slight concavity at the bottom fitted on the head of the statue. It is thought they were a crude attempt to ornament the statues with a structure similar to the top-knot.

The carving of human images from wood and less often from stone is one of the culture traits which distinguish eastern and marginal Polynesia from western Polynesia, where carving of human figures is less developed. Large stone images are carved only in the Marquesas, Raivavae, and Easter Island. Elsewhere in Polynesia wood carving preceded stone carving. The first immigrants to Easter Island probably came from eastern Polynesia, and were there acquainted with carving human figures from wood.

In the religious beliefs the bird-man cult held a most prominent place until the second half of the nineteenth century. As reconstructed from second-hand information it has no parallel in the rest of Polynesia. Though incarnation of gods in animals is a fundamental character in Polynesian religions, nowhere else do open competitions result in the election of a sacred man.

The tablets of the Rongarongo man—the famous wooden tablets covered with hieroglyphs—had associated with them sacred chants, which were sung by learned men or bards. Comparative study suggests that they are not so much inscriptions of the words of the chants as mnemonic. They are a puzzle to science, and the most complicated problem of Easter Island culture. Some tablets dealt with ceremonies, others were parts of ceremonies themselves. They were never read, but were used during chanting. No methodical analysis of the script has as yet been made. It is not phonetic or syllabic, but it may be a form of pictography. There is no doubt that the signs are symbolic and not decorative.

Parallels to the Easter Island tablets are found in the mnemonic devices of the Marquesas, which consist of a cylindrical bundle woven of coconut fibre, from which hang knotted cords. This bundle is often shaped like a human figure, and is supposed to contain the story of the gods. Other truly analogous mnemonic devices were developed in the Cook Islands, Tuamotus, the Society Islands, etc.

The mystery of Easter Island rests on the assumption that the culture of the island was too elaborate to have been invented by the inhabitants found there by the first European visitors. It was assumed that the monuments of the island were the expression of a civilization which had been destroyed either by a natural disaster or by invasion. It has been assumed also that the Polynesians represent a second wave of invasion; but of any theories of the origin of the original inhabitants the only one worthy of scientific consideration is that they were Melanesians. The parallels, adduced in support, however, are vague and indefinite.

As the result of the careful and exhaustive investigations by the Franco-Belgian expedition of the ethnological data now available, including material culture, past and present social structure, and religious belief, it is concluded that Easter Island was occupied by a single wave of immigrants belonging to the Polynesian race. Each region of Polynesia stressed and perfected an aspect of its culture—the Marquesas tattooing and the Maoris wood carving, and jade ornaments; and so also Easter Island came to develop giant statues without the interpolation of a sunken continent or a Melanesian invasion. Easter Island, in fact, is a local Polynesian culture which developed from an archaic and undifferentiated Polynesian civilization.

FLIGHT AND HABITS OF THE HUMMINGBIRD

SOMETHING close to perfection in flight has been achieved by the tiny hummingbird, the small but relatively powerful wings of which make possible speeds of close to fifty miles an hour and ability to manœuvre in the air probably superior to that of any other flying creature. This is explained by Dr. Winsor M. Tyler in a bulletin recently issued by the Smithsonian Institution, in which are described the habits of the familiar ruby-throated hummingbird, the only species ever encountered in the Eastern United States.

The wing beats sometimes are at a rate of seventy-five a second. The bird can take off from a perch in about seven-hundredths of a second. It can remain almost still in the air with about fifty-five wing strokes a second.

Perhaps the hummingbird's greatest achievement, however, is its ability to fly backward. This has often been reported and as often questioned as impossible; but recent photographic technique has shown that the reverse flight is an actuality. This is explained as follows:

"In backing away from a flower or feeding tube the hummingbird stands almost vertically in the air with its tail pointing downward and a little forward. In this pose its wings beat horizontally, and what would be the downward half of each complete wing stroke if the bird's axis were parallel to the ground forces the air forward, away from the bird's breast in its upright position, and drives the bird backward. Then, on the return half-stroke, the whole wing is rotated at the shoulder joint so that its upper surface strikes the air, and, driving it downward, balances the pull of gravity."

Other sidelights on this creature's ways of life are explained by the author. The hummingbird's spring migration northward keeps pace with the opening of its favourite flowers. Males and females usually migrate in separate groups. In fact, they remain apart most of the time, except for brief mating periods. The nest is a model of bird artistry, lined with soft plant down and covered on the outside with bits of lichen. It is usually entirely the work of the female.

The newly hatched bird is no bigger than a pea and entirely naked. The young probably are born blind. Growth is very rapid, and in less than two weeks the young birds are almost as big as their parents and able to leave the nest.

The hummingbird sips the nectar from blossoms, but a good part of its food consists of insects. Presumably it was originally exclusively an insect eater, specializing on those types likely to be found around blossoms. In this environment the bird has acquired an unappeasable taste for sweets. A single individual has been observed to devour two teaspoonfuls of sugar daily. A human being with a comparable capacity would devour about fifty pounds.

They show a strong preference for red flowers. This, the author believes, is not due to the attractiveness of the colour *per se* but to the fact that it is always the most striking against a green background.

Hummingbirds often seem to be nervous and irritable. They are intolerant both to each other and to other birds. In spite of their smallness they will attack much larger birds which invade their neighbourhood, relying on their marvellous dexterity of flight to win the conflicts. The special form of attack against a larger bird is a form of 'dive bombing'.

The song is high-pitched and has a "petulant" quality, reflecting the bird's irritable nature. Sometimes the notes are "angry-sounding, mouse-like squeals".

Because of its tiny size the hummingbird meets perils unknown to other birds. There are instances recorded where it has been caught in spider webs. It may become impaled on thorns or stuck to thistles or milkweeds. One instance is cited in which a bird was attacked and destroyed by a dragonfly.

'ISLAND' FAUNAS ON THE MEXICAN PLATEAU*

PROF. EDWARD H. TAYLOR,
UNIVERSITY OF KANSAS

ANIMAL life of Mexico is greatly diversified, and may be primarily divided into the lowland types and highland types. The lowland animals are largely an influx from Central America, after the union of Mexico and Central America. The highland fauna is itself extremely diversified. Considering primarily the herpetological faunas, very few species, if any, have spread over the entire highlands. A great many of the species appear to be distributed in groups occupying very limited areas—much like the distribution of animals in a group of islands. Thus south of the Balsas River there is an area that can boast of 64 species—some 22 snakes, 20 frogs and toads, 22 lizards, not to be found elsewhere in the world; and a total absence of salamanders.

To the east a distance of perhaps two hundred miles in the higher part of the adjoining State of Oaxaca is another 'island', perhaps half as large as the preceding, that has 31 species of reptiles and amphibians not known elsewhere—including 7 salamanders, 10 snakes, 9 lizards and 5 frogs. The exploration of this 'island' has scarcely begun.

The highland region about the City of Mexico and to the east, including the great volcanoes of Orizaba and Popocatepetl, the highest, coldest part of the plateau, has some 25 amphibians and reptiles not known elsewhere, including 5 salamanders, 10 snakes, 10 lizards, and 8 frogs and toads. Just north of this plateau cap is an area which includes much of the State of Hidalgo, which has some 30 species that are not known elsewhere in the world, and still is little explored. Farther north around the city of Saltillo is another, similar, but as yet little-explored, area with several species confined to the highlands of this region. Other similar 'islands' occur in the little-explored western Sierra.

Thus in this highland mass of Mexico these groups total about 280 species of reptiles and amphibians, known from nowhere else in the world, each group occupying its own limited area. Moreover, most of these areas are not contiguous with adjacent 'islands', but are usually separated by some distance. In the Rocky Mountains north of New Mexico and Arizona —a territory nearly as great as that of the Mexican highland—there is apparently not a single endemic species of Reptilia or Amphibia that has evolved.

This 'island-like' grouping of the reptiles and amphibians is not due to strongly differentiated physical or environmental factors of rainfall, temperature, etc., that might normally be expected to limit animal groups into faunal districts; it may in some measure reflect altitude; but they are not typical 'fauna regions'. It would appear that this has been due to ancient isolation.

That these island-like conditions of distribution obtain on the Mexican highlands strongly suggests that much of the evolution of Mexican animals took place prior to the uplift of the highlands; that in this region prior to the uplift there existed groups of islands surrounded by shallow seas—an archipelago perhaps similar to the West Indian Islands of to-day, that had been formed by subsidence of a once continuous land mass that had a rather homogeneous fauna.

Evolution continued for long periods, each island isolated from its neighbour changing the original stock as it could. Then with re-elevation the faunas still reflected their individuality by these island-like areas on the highland.

Further study of the faunas points strongly to the presence of two islands where the present peninsula of Lower California exists to-day, and the probability that the upper was joined to the Mexican mainland and separated from California; that the union between Central America and Mexico was not made until long after the uplift of the Mexican highlands; that the western coast has been sinking in relatively recent times, as shown by close relationships between the faunas of small islands and the mainland along the western coast.

* Substance of a paper read before the Eighth American Scientific Congress held at Washington during May 1940.

DECONTAMINATION OF ELECTRICAL EQUIPMENT

THE Government has published full instructions for decontamination of electrical equipment, but, of necessity, these relate only to general conditions and do not deal in detail with the many specialized materials used by the electrical industry. In order to obtain more definite guidance on decontamination of equipment, the North Eastern Electrical Supply Co., Ltd., convened a committee to study this question. A report was submitted to the Ministry of Home Security and was amended according to its observations. The final report approved by the Ministry is now being issued by the Electricity Commission and should form a valuable guide to the industry.

After briefly reviewing the general principles of decontamination, the report states that there will be no immediate danger from the continued operation of contaminated plant, except in the case of bad contamination, when the electrical contamination of the plant itself may alter. There is, however, danger to personnel from the vapour which may arise from the contaminated gear if it becomes warm. The first action is directed towards removing the danger to personnel. Where it is impossible to shut down the plant to carry out complete decontamination, as much as possible should be done and danger notices should be placed on the remaining contaminated parts, with suitable ventilation provided to remove the vapour being given off. Successful decontamination is chiefly dependent on prompt application of the necessary treatment.

Insulating panels and metal can be cleaned by rags soaked in solvent and removing the excess solvent by clean rags. Sometimes solvents are effective. It is necessary in bad cases to strip the surface. Coils should be treated with solvents preferably sprayed on and afterwards wiped dry. In the case of electrical machines, they should be cleaned with solvents as much as possible, and then given a run at full load. The heat generated will vapourize any remaining liquid and so complete the decontamination. Adequate ventilation must be provided to remove the vapour and a gas inspection officer may be required before the plant can be declared free from contamination.

Lead-covered cables can be cleaned with solvents; but when the sheath is damaged the cable should be replaced. In the instructions the effect of blister gases on various insulating materials is shown in a lengthy table. In general, mustard gas penetrates a material, either by creeping along pores or fibres as in paper and brickwork, or by dissolving in the material as in bitumen, paraffin wax, etc. The first-mentioned class allows the gas to evaporate and can be affected by the destructive action of moisture on the gas. The latter class retains the gas for a long time, and only complete destruction is satisfactory. With regard to the type of solvent to be used, light oils have the advantage of being neither toxic nor inflammable. Paraffin is cheap and easily obtainable. A footnote is added to the report on the decontamination of areas affected by calcium arsenide. The most practical method is to hose the area liberally with water. This will at once liberate the arsine gas, which will be rapidly dispersed. Respirators must be worn but anti-gas clothing is unnecessary. On electrical apparatus the powder must be swept off and a blower used on the inaccessible places.

FORTHCOMING EVENTS

Tuesday, October 8

INSTITUTE OF FUEL (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.15 p.m.—Mr. W. Boon: "Some Thoughts on Coke".

ILLUMINATING ENGINEERING SOCIETY (in the Lecture Theatre of the Royal Institution, 21 Albemarle Street, London, W.1), at 2.45 p.m.—Prof. J. T. MacGregor-Morris: "The Arc as a Standard of Light" (Presidential Address).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHER OF MATHEMATICS, PHYSICS AND PHYSICAL TRAINING at the Barnsley Mining and Technical College—The Principal, Technical College, Church Street, Barnsley (October 9).

DEPUTY BOROUGH ELECTRICAL ENGINEER—Mr. G. R. Spurr, Borough Electrical Engineer, Electric House, Church Hill, Walthamstow, E.17 (October 18).

DEPUTE ENGINEER AND MANAGER of the ELECTRICITY SUPPLY UNDERTAKING—The Engineer and Manager, Electricity Supply Department, Dewar Place, Edinburgh 3 (October 18).

GRADUATE LECTURER IN ENGINEERING—The Principal, Wigan and District Mining and Technical College, Wigan.

ASSISTANT ENGINEER for the DRAINAGE AND IRRIGATION DEPARTMENT, Malaya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9316).

ASSISTANT MASTER for GENERAL SCIENCE AND MATHEMATICS at the Bath Technical College—The Director of Education, Education Department, Guildhall, Bath.

TEACHER OF ENGINEERING (PRACTICAL MATHEMATICS, ENGINEERING DRAWING AND ENGINEERING SCIENCE) at the Falmouth Day Continuation and Technical School—The Clerk to the Governors, District Education Office, Falmouth.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Edinburgh and East of Scotland College of Agriculture. Calendar for 1940–1941. Pp. 66. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [249

British Museum (Natural History). Economic Leaflets No. 4: Psocids, Book Lice, Dust Lice, etc. Pp. 4. ½*d*. Economic Leaflets No. 5: Crickets. Pp. 4. 1*d*. (London: British Museum (Natural History).) [249

Other Countries

Bulletin of the American Museum of Natural History. Vol. 76, Art. 9: Lagomorpha and Rodentia other than Sciuridæ, Anomaluridæ and Idiuridæ, collected by the American Museum Congo Expedition. By Robert T. Hatt. Pp. 457–604+plates 7–19. Vol. 77, Art. 3: A Revision of the Rotatorian Genera Brachionus and Platyias, with Descriptions of One New Species and Two New Varieties. By Elbert H. Ahlstrom. Pp. 143–184+plates 2–20. Vol. 77, Art. 4: Studies on the Earliest Primates. By George Gaylord Simpson. Pp. 185–212. (New York: American Museum of Natural History.) [179

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 35: Progress of Veterinary Research in India during the Past Twenty-five Years. By F. Ware. Pp. ii+37. (Delhi: Manager of Publications.) 1.2 rupees; 1*s*. 9*d*. [179

Records of the Botanical Survey of India. Vol. 5, No. 5: Plants of the Lloyd Botanic Garden, Darjeeling. By Dr. K. P. Biswas. Pp. iv+369–478. 3.14 rupees; 6*s*. 3*d*. Vol. 14, No. 1: A Revision of the Labiatæ of the Indian Empire. By Dr. S. K. Mukerjee. Pp. iv+228+viii. 5 rupees; 8*s*. (Delhi: Manager of Publications.) [179

New Zealand. Fourteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 100. (Wellington: Government Printer.) 2*s*. [179

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 30, Memoir No. 1: The Jurassic Brachiopoda of the Namyan Beds of the Northern Shan States, Burma. By Dr. M. R. Sahni. Pp. v+46+4 plates. (Calcutta: Geological Survey of India.) 2.10 rupees; 4*s*. 3*d*. [189

Melk in het buzonder als Zingelingenvoedsel. Door Dr. J. H. de Haas an Ir. O. Meulemans. (Uit de Kinderkliniek der Geneeskundige Hoogeschool te Batavia.) Pp. vii+104. (Batavia: M. Vervoort.) 2.75 f. [199

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 99: Studies on Chemical Weed-Killers with Special Reference to Skeleton Weed. By C. G. Greenham, Dr. G. A. Currie and F. E. Allan. Pp. 48. (Melbourne: Government Printer.) [259

NATURE

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Editorial and Publishing Offices :

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number : City 4211

Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 12, 1940 No. 3702

SCIENCE AND THE NATIONAL WAR EFFORT

THE recent changes in the membership of the Cabinet, coming as they did on the same day as the announcement of the appointment of a Scientific Advisory Committee responsible to the Lord President of the Council (see page 485 of this issue), will probably have overshadowed in the public mind the significance of this Committee. A scrutiny of the terms of reference, and consideration of the qualifications and standing of its members, however, will bring the realization that in this Committee we have a means of putting science into direct contact with the innermost councils of the Empire. How much this may mean for the outcome of the present conflict, and beyond that, will depend on the speed with which the Committee pursues its inquiries, the vigour with which it urges its conclusions on the Government, and a receptive mind on the part of the leaders of the country.

During the past twelve months, there has been a feeling among scientific workers, both as organized bodies and as individuals, that insufficient use was being made of their knowledge and special qualifications. Reference has frequently been made in these columns to the dissatisfaction and sense of frustration, for which the only answer hitherto has been a certain amount of lip-service to science from responsible politicians. We have been told time and time again that this is a scientific war, and that the German use of scientific developments must be met by ever more intensive application of science ; but little came of it, apart from extensive development of the scientific departments within the ministries. There seemed no realization of the need for a major step in the improvement of the organization, for the provision of a focus through which the increasing activities of scientific departments could be linked together. Sir William Bragg hinted at the prevalent anxiety in his presidential address to the Royal Society last November ; and he made a definite suggestion for the constitution of a consultant panel of eminent scientific workers, that would give advice and also be kept informed of the progress of events, so that "it might foresee occasions and needs". In other words, Sir William was suggesting more than the usual committee, pursuing its investigations and making recommendations which would be forwarded to the Government through the usual departmental channels and thereby subjected to delay and, alas, often ill-informed and destructive criticism. He asked for a body with access to, and authority with, those who lay down policy.

Such a committee would, of course, have been a new departure in the system of government in which we have grown up. But evolution rather than revolution has ever been a characteristic of political history in Great Britain, and Sir William Bragg's suggestion, elaborated no doubt in association with the officers and Council of the Royal Society, was, we presume, rejected by the Government on other grounds than novelty. The scheme now adopted, although superficially it may resemble the older one, has an important difference. The members of the Committee, apart from the chairman, are indeed all fellows of the Royal Society, but three of them are in the public service, namely, the secretaries of the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council, and the other three are the president and secretaries of the Royal Society. By this means a judicious mixture of the official and unofficial is provided, and the members should be in intimate contact

with scientific and technical developments wherever they occur.

The need for outside and independent criticism of the activities of scientific and technical departments under Government control will readily be conceded. This is no reflection on the integrity and capabilities of the many eminent men working in these departments ; it is one of the defects of the present system. Few of the political leaders of Great Britain have anything but a nodding acquaintance with science or technology, and they can get little help in this field from Civil Servants in the higher administrative posts. In consequence, the scientific and technical officers of departments become either the servants of the administrative side, with little possibility of taking a hand in the formulation of policy, or else—and more rarely—their advice is followed blindly. Neither result is likely to be productive of the critical yet flexible and responsive attitude of mind which is required under modern conditions. Coupled with the departmental scientific advisers there should be a source of independent opinion, to the recommendations of which the minister himself may be expected to give weighty consideration.

There are in existence several such advisory councils or committees, which have fully justified the hopes entertained of them. The three research departments of the Privy Council, namely, the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council, have all worked from their formation by means of councils or committees consisting mainly of independent scientific workers, which have largely defined policy as well as administered research projects. The scientific work of the National Physical Laboratory is controlled by a body appointed by the Royal Society. The Aeronautical Research Committee, which includes many independent members, has for many years been responsible for research and development in aeronautics in Great Britain, as its many publications have shown.

To come to appointments directly concerned with warfare, there is the Committee for the Scientific Survey of Air Warfare, set up in 1935, which came to an end in June last at about the time when the Ministry of Aircraft Production was formed ; this Committee was of much service to the Air Ministry, and many of the methods now used in air defence are due to its initiative. The Chemical Defence Committee, which continued for many years to advise the War Office and now the Ministry of Supply, has a number of independent members. The Civil Defence Research Committee has done valuable work for the Ministry of Home Security. The Ministry of Supply is well served by the Council for Scientific Research and Technical Development, formed early this year, the various committees of which have the right, and the duty, of inspecting and advising upon the scientific and technical work of the establishments of the Ministry.

The Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council are, of course, closely connected with the work of the Ministries of Agriculture, Health and Food, but they are responsible to the Privy Council, and their scientific councils have no direct means of ensuring that the best means for the fuller utilization of scientific and technical advice are adopted in these departments. The Fighting Services and other ministries are for the most part even less well served, so far as outside and independent critical opinion is concerned.

It is in this matter of providing opportunity for the voice of scientific men outside Government service to be heard in the deliberations of the various ministries, although not strictly within its terms of reference, that the newly appointed Scientific Advisory Committee may be able to perform a vital service. It is not a question of appointing a number of committees, ringing the changes for the several departments on the names of a few senior men of science, but rather of finding talent among the younger men, that their fresh minds may leaven those of the elders, and that their shoulders may early learn to bear the burden of responsibility.

In the conflict in which we are engaged, nothing short of the mobilization of the whole of the intellectual and material resources of the Empire will suffice. The contribution of science to the war effort should be a major one, for which the Scientific Advisory Committee may well be largely responsible. Moreover, the work must not cease with the end of the War. It does not follow that an organization which is satisfactory under the stress of modern warfare will serve equally well in times of peace ; but the principle of the immediate concern of science in formulating policy and in other ways exerting a direct and sufficient influence on the course of government is one to which we must hold fast. Science must seize the opportunity to show that it can lead mankind onward to a better form of society.

SOCIAL REHABILITATION

ONE of the consequences of the social disturbance and distress which have accompanied the widespread destruction of private property in the indiscriminate bombing attacks on London and other areas has been the realization that problems of social reconstruction have to be faced now and cannot be deferred until the end of hostilities is in sight. Whatever evacuation or shelter policy may now be adopted must be part of a long-term policy, keeping in mind the possibility of a long war, and designed to conserve morale and resources as effectively as possible. Short-sighted temporizing and timid palliatives are a public danger, and can no more be tolerated than the administrative incompetency from which they spring.

Recent events have made it plain beyond question that planning for social reconstruction must be undertaken in the midst of the War and as part of its effort with a vigour, a vision and a courage worthy alike of the gallant few on whom the main brunt of defence has fallen, the heroism of the civil defence services and the patient fortitude of those who have seen their homes and families shattered and scattered. The relief of distress in the stricken areas, evacuation of non-essential classes from the more dangerous districts no less than the restoration of public services which have been interrupted or dislocated, and other measures of social rehabilitation are tasks calling for immediate attention. None the less they should be handled not merely in respect of immediate and urgent needs but also in relation to the long-range problems of social rehabilitation and reconstruction which will confront us after the War.

The relief of distress and social reconstruction in the heavily bombed areas represent only one aspect of the question of social rehabilitation. The nation is equally committed to the care of its fighting men; to see that when the War is over they may secure their places in civil life or find new places in which their energies can be employed. The care of the disabled soldier and of those suffering from cardiac, nervous and other afflictions is a particular aspect of such rehabilitation, and as to the value of this work the experience of the War of 1914–18 leaves no room for doubt. Equally that experience warns us of the danger of allowing what promised to become the foundation of a great national effort to dwindle to meagre or insignificant proportions. If justice is to be done to our fighting men, our gratitude to them to find adequate expression and even our pledges honoured, now is the time to look forward, to plan on an adequate scale and take such immediate steps as will prevent us again missing our goal.

If this is one of the main reasons for giving attention to such problems of social reconstruction at this hour, to ensure that the lines of an adequate policy and necessary measures and resources are available when the need for action arrives, so as to avoid the confusion and mistakes that are inevitable if we wait until such problems urgently arise, there is another equally as important. Our immediate problems and needs are related in a remarkable way to our long-range problems in this field, and attention to the latter requirements in dealing with the former may well assist to conserve our resources as well as facilitate reconstruction after the War. What is even more important is the contribution which such vision and long-range planning may make to public morale.

It is impossible to take a cross-section of opinion in Great Britain to-day without realizing the extent to which social reconstruction looms in the minds and thoughts of almost all sections of the community. The realization that the struggle is fundamentally between two entirely different social orders, between one in which the State is supreme and the individual is without rights and exists merely to serve the State, and one in which the State exists to serve those needs of individuals which must be met collectively in an ordered society, is widespread. Many indeed are coming to look for a new social order from which the grosser inequalities of wealth and opportunity have been eliminated and in which a finer tradition of public service is shared by all. If into such planning and reconstruction as are demanded now we could get something of this spirit and vision we might well give to those on whom have fallen the severest blows and heaviest strain just that inspiration and hope which count for most in maintaining morale and endurance under the War's sternest trials.

Such a possibility cannot be dismissed as impracticable or Utopian. We are apt, as Prof. J. H. Jones has pointed out, to exaggerate the real and enduring suffering caused by war and to assume the inevitability of poverty for long years after the War has come to an end. Such poverty is not inevitable if the resources of Nature, of technical skill and energy which will remain, with most of our capital resources are used with imagination and effectively organized. We have already indicated how reconstruction in the stricken areas, whether undertaken now or after the War, might be carried out in accordance with an adequate national plan and not marred again by limitations imposed by departmentalism, parochialism or vested interests. Similarly in the field of rehabilitation of the fighting men, as Dame Agnes Hunt has pointed out, there is real need for co-ordination in view of the many organizations concerned. Coordination, if it is to be effective, must stand above medical and vocational treatment and reemployment, with its corollary of a scale of pensions. Some rearrangement of existing responsibilities is necessary.

If the Ministry of Health, for example, acting through its Emergency Medical Service, assumed some of the duties now being discharged by the Ministry of Pensions and by the Board of Education, the ideal of a National Medical Service would be appreciably nearer realization. The Ministry of Health would thus become the sole authority of State on medical and surgical questions and would be in a position to lay down broad principles of procedure for the guidance of the secular ministries. Moreover, the work it is at present doing for disabled soldiers would thus become the basis not only of re-education but also of reemployment, and a beginning would have been made with the task of dealing with persons unable to perform heavy work or to work continuously.

The importance of this to industry is obvious, and equally its special value at the present time when our War effort demands the maximum utilization of man- and woman-power. The development of a National Medical Service in this way might well enable us to restore to industry without danger, not only many of the victims of tuberculosis as the work of the Papworth Village Settlement has shown, but also those of some cardiac and nervous and other chronic diseases if adequate steps were taken to secure their welfare. Even if such additions to our industrial resources were not effected in this way during the present War, we have here yet another striking example of the way in which far-sighted, long-range action is of benefit to our immediate purposes.

What must be kept particularly in mind is the importance of undertaking the requisite study of such problems now as a prelude to planning. For this reason alone the publication of Mr. D. M. Goodfellow's study of Tyneside (see p. 485 of this issue) is opportune. The social and industrial disturbances of war inevitably leave a legacy of problems. Areas of intense industrial activity in war-time are practically depressed areas in peacetime. Migration, whether of workers into centres of industry to increase production, or of workers and factories to less vulnerable and non-industrial parts of the country, are apt to involve distortion of development, lack of balance in productive capacity and of variety of occupation. The consequent problems to which attention in war-time is imperative even on the bare ground of production become even more acute when redistribution has to be faced after the War.

The Royal Commission on the Geographical Distribution of the Industrial Population in its recent report frankly faced a number of the problems of industrial dislocation at the end of the War, which indeed its recommendations are designed to mitigate. Mr. Goodfellow's report is concerned much more with social and welfare conditions, but equally emphatically he emphasizes the need for preparing plans for the transition well in advance and ready for application. Like the Barlow Commission, he stresses the need for coordination and for relating the measures of the Government, the local authorities and industry.

Social preparations must be planned and readjustments can no longer be left to chance. On that the investigations of Mr. Goodfellow and the members of his tutorial class organized by the Workers' Educational Association leave no room for doubt. They also trace the lowered vitality on Tyneside to-day back to a false prosperity which reached its apex during 1914–18 and weakened resistance in the long depression which followed. The scarcity of essential foods, and overcrowding and deficiencies in cleanliness and the normal care of children, partly through the absence of mothers working in the factories, played their part, and it needs little imagination to realize how serious a situation might well arise during the present War, let alone after it, even leaving out of account the disturbance and dislocation which heavy air attack may cause.

To some of these dangers the Government are already clearly alive, but one of the most significant features of the report is the fresh support it brings to the recommendations of the Royal Commission of Local Government in the Tyneside area. This acute piece of analysis emphasizes the erratic character of the Tyneside social services. They in no way correspond to the needs of the whole area. In many important services only Newcastle-upon-Tyne reaches the national standard. In others, some Tyneside towns make special efforts and rise far above that standard, while others fall far below it.

This inordinate disparity in the health and other social services on Tyneside is not always determined by poverty. Some of the poorest Tyneside towns make the best efforts to improve the conditions of their citizens, but do so only by taxing these citizens and so intensifying poverty. It is for this reason that Mr. Goodfellow sees danger in the formation of a region consisting of industrial Tyneside and Northumberland County as likely to lead to an over-emphasis of agricultural interests and continued disparities of social services. He recommends that Durham should be included from the first, if only because of Durham's excellent achievements in the development of social services, which indicate an attitude likely to be beneficial if not essential to the development of Tyneside.

Mr. Goodfellow suggests, however, that the division of local services into two types, regional and local, requires more consideration. In his view a regional authority for all purposes, controlling all services and strengthened by ownership of public utilities, would stand the best chance, without any danger of friction from minor authorities within its own boundary, of satisfying the conditions of the reports of the Barlow Commission. Such a regional authority would be able to speak with one voice as regards the industrial development and planning of the north-eastern region, its equitable treatment by the national exchequer, and the uniform development of its social services on the lines required by both industrial and agricultural districts. It might well also encourage the local development of the potential resources in leadership.

The value of this survey at the present time is unmistakable. It is a timely reminder that social welfare, the quality of the health and social services, cannot be let down at any time, even amid the desperate need of war, without the exaction of a heavy penalty later. Industrial and social policy must be brought together in a comprehensive welfare policy. Scientific workers will recognize Mr. Goodfellow's investigations as a sample of what might well be attempted elsewhere as a prelude to planning for social reconstruction. They should be grateful also for the stimulus it gives to the scientific consideration of the larger issues involved in regionalism. War-time developments have already opened up wider possibilities which might be utilized in the development of our plans for reconstruction after the War.

These possibilities cannot, even in the stress of war, be left purely to chance. Even now we must turn all available scientific energies to studying the causes of our difficulties. We cannot clearly prophesy to-day what form the society of the future will take, but as Mannheim has pointed out we need a new kind of foresight, a new technique for managing conflicts, together with a psychology, morality and plan of action in many ways completely different from those which have obtained in the past. It is only by re-making man himself that the reconstruction of society is possible. A conscious attack on the sources of maladjustment in the social order in this way, based on a thorough knowledge of the whole mechanism of society and the way in which it works, an attack on the strategic points and not the treatment of symptoms, might well yield results far beyond expectation and make some of the sacrifices of the War well worth while.

Scientific workers carry an inescapable responsibility for helping their fellow citizens to see and face these possibilities and responsibilities. They might well lend their support to such a central body as the Reconstruction Commission advocated by Prof. Jones, or sectional groups concerned with particular problems like the Architects National Council, which are attempting to study, collate and co-ordinate the changes that are occurring and the problems which emerge. Certain it is that if we are to see the health of the nation adequately safeguarded during and after the War and those whose lives have been disrupted, whether physically, mentally or spiritually by the impact of War, rehabilitated and established in a new social order, the planning and action must be based on fearless scientific investigation and courageous and far-sighted administration, untrammelled by departmentalism or prejudice.

AN ISLAND NATURALIST

Island Years

By Dr. F. Fraser Darling. Pp. xii + 306 + 23 plates. (London: G. Bell and Sons, Ltd., 1940.) 12*s*. net.

IN "Island Years" we have an account, written most attractively, of a life which the author, along with his wife and his growing son, has lived (and still lives) on lonely Hebridean islands, uninhabited except by this little family.

The first island which Dr. Fraser Darling and his wife chose for their home was Eilean a' Chleirich, one of the Summer Isles, which lie off the coast of Wester Ross. Thence they migrated to Lunga, one of the Treshnish Isles, where they made a late autumn camp in order to study the habits of the Atlantic seal—and all the time the idea was taking shape of a more daring stay on Rona, a very lonely, storm-beset island lying 47 miles out to sea north-east of the Butt of Lewis. No one had hitherto thought of camping on Rona in the stormy late autumn season when the Atlantic seals in their thousands come ashore to drop their pups, but the Fraser Darlings braved a part of a winter there and faced gales so tremendous that those strong birds the greater black-backed gulls became quite exhausted and permitted themselves to be caught and lifted by human hands. Although the author does not say so, the photograph (illustrating p. 227) of Rona under snow to the water's edge depicts a very rare scene. I well remember the week in December in which the photograph was taken and never either before, or since, had I seen from my home in Skye the lesser isles of ocean snow-clad so completely.

Dr. Fraser Darling is a trained and observant naturalist. In his observations on the Atlantic seal he gives us much new and valuable data concerning the habits of these animals: his notes on that rare nocturnal bird, Leach's forked petrel, are also noteworthy. He mentions that he obtained a midnight flashlight photograph of this bird in flight: one could wish that it had been included in the illustrations, all of them excellent, of this book.

One learns with interest that the rock dove, numerous in Skye, does not nest on Rona; also that barnacle geese, which winter on almost all suitable Hebridean islands which are uninhabited, are absent from Rona.

There are so many interesting and delightful passages in the book that it is difficult to pick out the most attractive, but the account (p. 255) of the joy of the Atlantic seals as they battle with enormous seas is outstanding. Fraser Darling describes in restrained yet vivid language the occurrence (p. 262) of the 'green ray' at the moment of sunset at 10.10 p.m. after a day of restful beauty. I like, too, his description of Loch Fada (p. 50), and I am glad to see that he appreciates the aroma of the crowberry. This, to my mind, is one of the most fragrant and characteristic scents of the hills and moors, yet no other author I have read appears to have noticed it. On p. 48 Dr. Fraser Darling gives an interesting account of a peregrine falcon preying on little auks, and on p. 106, of barnacle geese alighting on the sea. I once saw this, from the same island group from which the author records it.

Writing of the eiders of the Summer Isles (p. 113), Dr. Fraser Darling mentions that their eggs hatch during the third and fourth weeks of June. Their laying must therefore be considerably later than the nesting season of the eiders of the mainland seaboard of the neighbouring county of Inverness where, on June 1 of the present year, I saw more than one brood of young eiders swimming actively in the shallow water of an ocean bay, accompanied by their parents. It is interesting, too, that the stormy petrels of the Summer Isles (p. 126) do not arrive at their nesting haunts until early June, whereas R. M. Lockley has chronicled that on the island of Skokholm (which lies off the coast of Wales) they first make their appearance as early as April. By the way, this species (p. 127) does not *always* "shuffle away on its hocks into its crevice" when disturbed, for I have on occasion seen them walk, upright and graceful. The statement that the legs "though of fair length, will not support the bird in the upright position of a robin or sparrow" is therefore not altogether accurate.

It is interesting to know that skylarks do not arrive at Dundonnell until April, because at my home in the north of Skye, where the species is abundant, they arrive with regularity in mid-February, regardless of the weather conditions then prevailing.

In this book unusual words are occasionally met with. "Cormorantry" as the name of a colony of nesting cormorants is new to me; so also is "rinze" heather.

"Island Years" is one of the best books of its kind that has been published, for the author has done things no other man has done, seen sights no other man has seen, and is master of a style so vivid that these rare sights and sounds are conveyed faithfully and without effort to the reader.

S. G.

WOODLANDS IN AGRICULTURE

The Management of Farm Woodlands

By Cedric H. Guise. (American Forestry Series.) Pp. x+352. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20s.

At the outset, farm woodlands are defined as areas of wooded growth that are integral parts of the lands used primarily for agriculture. As such they serve various useful purposes in affording protection to buildings and stock, in preventing undue soil erosion and, if skilfully managed, in providing profitable timber of various types. The problems of agriculture and forestry are inseparable in regions where the better soils are utilized for crop-growing and pastures, and woodland occupies the area of poorer quality. Detailed tables show how widespread these woodland areas are in the United States, the total value of the produce used and sold therefrom amounting to 190 million dollars per annum.

Good management of woodland entails the adherence to a definite policy based on sound technical forestry methods. Much improvement can be effected by judicious cutting, ranging from the provision of small wood for domestic purposes to the taking out of mature timber. In this, care is necessary to prevent injury to other trees from decreasing future profits. A management plan and simple book-keeping for each parcel of wood, combined with adequate selling arrangements form the basis of profitable woodland cultivation.

The volume under review is essentially a practical exposition of the knowledge and methods required to render the woodland a profitable section of the farm economy. The outline of woodland ecology describes the various types of growth, the light and temperature requirements of different species, and their susceptibility to diseases and pests, and provides lists of the most important trees associated with certain areas. A valuable section deals with methods of determining the volume, increment and yield of woodland products and the production of surveys and maps. Under the heading of protection the damage done to trees by grazing is emphasized, since usually a wood has little real value as a source of food for grazing animals, and both animals and woodland are likely to suffer.

Chapters on the utilization and marketing of woodland products, the durability and preservation treatment of wood and the general principles of management round off a book which should prove of great value to sylviculturists in all parts of the world. While the theme is woodlands in the United States, the text is of much wider application, and should be read with profit by all who are interested in the full utilization of all types of agricultural land. W. E. Brenchley.

COLOUR AND MUSIC

Colour Co-ordination

By M. Sargant-Florence. Pp. 352. (London: John Lane, The Bodley Head, Ltd., 1940.) 15s. net.

Many years ago, McDougall suggested that much confusion of thought on the subject of perception would have been avoided if all philosophers had been born blind. To this we might add that it would have been well if all colourists had been born deaf; and we might even begin to wish that Newton had never been born at all.

To such heresies are we driven by this book on colour co-ordination, which is devoted to establishing a theory of colour harmony by analogy to the theory of harmony in music, an idea which originated in the main from Newton. In his day, practically nothing was known of the mechanism of colour perception, and in the nature of things his suggestion could have been little more than a guess. The truth is that, even at the present day, our knowledge of the colour processes is so imperfect that it is quite impossible to say why some colours harmonize and others clash.

No one will grudge artists their attempt to establish an arbitrary system of colour harmony, although some of us may wonder why they should need it, and we may suspect that the greatest artists have done quite well without it. We would, however, admit that in teaching the less gifted among us, a system is useful, although its limitations may be dangerous. If we can assume that those with artistic leanings are likely to be conversant with musical theory, there is even something to be said for choosing music as the analogy. The real grievance of the man of science is different. What he must object to is the attempt to bolster up any analogy with pseudo-scientific ideas that must inevitably mislead those who have had no scientific training.

Newton's idea was based essentially on the

comparison of the visible spectrum with an octave in music. The analogy has been fortified in detail by comparing the angles of refraction of different coloured rays through glass with the intervals in a musical octave. A glance at a modern glass list would immediately make one pause before trusting too much to a theory based on the dispersion of one particular glass. But there are in any event several difficulties about this octave business, not the least of which is that, as reported recently, young observers who have been operated on for cataract can see the near ultra-violet, and at a wave-length of 3,600 A. the colour is blue. On the octave theory, one would presumably expect it to be red. However, there is little scientific information in this book more recent than Newton's investigations ; there is certainly no mention of the hue discrimination curve nor of the locus of the spectrum colours in the colour triangle—two vital pieces of information in a discussion of this sort.

To overcome the difficulty that normally only one octave is visible, the author suggests that "the spectrum octave can be extended into a gamut of many octaves by definite manipulation in degrees of luminosity. [He appears to mean saturation.] But this extension does not find expression in terms of wave-vibration." Yet if the analogy is to find expression in any terms at all, wave-vibrations are the only possible terms.

As an instance of the misinterpretation of scientific data, the author refers to the fact that so-called monochromatic radiations may, when examined in an instrument of high chromatic resolving power, be found to break up into several components. He then concludes that the overlapping of these components may be responsible for the whiteness of different parts of the spectrum. Unfortunately, one cannot reasonably expect an artist to see the fallacy in an argument of this kind.

The trouble is that this book is symptomatic of the wide gap between the artistic and scientific approach to colour. Is it too much to hope that something may be done before long to bridge it ?

W. D. WRIGHT.

MUSICAL ACOUSTICS

The Musical Ear
By Ll. S. Lloyd. Pp. ix + 88 + 2 plates. (London, New York and Toronto : Oxford University Press, 1940.) 6*s.* 6*d.* net.

MR. LLOYD has done a public service by writing a book on musical acoustics which, while giving the latest results of scientific investigation, approaches the subject from the point of view of the musician. Too often the latter has had to complain of the attitude which many who write for him adopt ; that he ought to have taken a course in mathematics and physics at least up to university intermediate standard before reading their works, forgetting that, so overcrowded is the curriculum to-day that a knowledge of physical acoustics cannot be assured even to science students unless they have taken physics as one of the principal subjects of a degree course. It is true that it is impossible to write on sound nowadays without introducing concepts like frequency and phon or their equivalents, but Mr. Lloyd wisely does not confound his readers with an introductory chapter or appendix containing a long list of definitions. Instead he cleverly avoids defining many of the terms he has to employ, leaving the reader to sense their meaning from the context.

As for the contents, they form a series of essays on topics which embrace the relationships between physical acoustics, musical sounds and theory, and the ear—especially the ear. The author elaborates a point which the physicist and—more so—the musician is apt to overlook, namely, that the ear is, or should be, the final arbiter in sound experiments and that as an organ of response it has its limitations and idiosyncrasies. To the best of its ability it measures loudness, not intensity ; pitch, not frequency ; timbre, not overtone structure. In other words, a treatise on acoustics has a serious lacuna if it does not deal with the sensation of hearing. Pre-occupied with this aspect of music, the author is a little severe on Ellis who did, according to his lights, expound and amplify Helmholtz to the English reader. Mr. Lloyd also has an affection for mechanical rather than the more recent electrical methods of analysis and synthesis of musical sounds. In the essay entitled "Electronic Organs and the Phonodeik", the reader will find nothing about the former but a great deal about the latter. No one decries the importance of the pioneer work of Miller in this field, but the reader is not told that Miller had to apply a rather arbitrary calibration correction to his analyses with the phonodeik, a calibration which is largely avoided in modern electric wave analysers, by the possibility of omitting resonance cavities and bodies which were necessary in mechanical recording to produce the desired amplification.

A GREAT SWEDISH ASTRONOMER

Pehr Wilhelm Wargentin
Kungl. Vetenskapsakademiens Sekreterare och Astronom 1749–1783. Av N. V. E. Nordenmark. Pp. 464. (Uppsala: Almquist and Wiksells Boktryckeri A.-B., 1939.)

THOUGH Wargentin in his lifetime enjoyed a reputation which was both great and widespread—he was a foreign member of the Paris Academy of Sciences, of the Royal Society, of the St. Petersburg Academy and other similar bodies—he is probably little remembered outside his native land except by astronomers. Even in that circle he is known, perhaps exclusively, as an assiduous student of Jupiter's satellites in the days before Laplace investigated them as a dynamical system. In this voluminous memoir Wargentin is shown as a prominent figure in Swedish science in the great days of Linnæus and Scheele. In his versatility and by certain specific activities he is related to the Halley of the preceding generation. The memoir is in Swedish, but it includes (pp. 310–336) a résumé in French.

P. W. Wargentin was born in 1717, and as he died, like Euler, in 1783, he was an exact contemporary of d'Alembert. He was a student at Uppsala in 1737 when Celsius returned from abroad and resumed his chair of astronomy. As the subject of his thesis for the master's degree Celsius proposed the motion of Jupiter's satellites. At the time Jacques Cassini's new tables were expected to appear (1740), and the candidate was intended to include some discussion of them. As it fell out, the copy ordered from Paris was delayed in transit. Accordingly, Wargentin prepared fresh tables for himself, based on such observations as he could find. This was done with such success that the new predictions not only surpassed those given in the "Connaissance des Temps", based on the tables of the elder Cassini, but also those derived from the belated new tables of the younger Cassini. This was a real triumph, but it was followed by a catastrophe. On a journey to Stockholm at the end of 1741 the MS. of the tables was stolen from the coach, and Wargentin was faced with the task of repeating his work, which took two years to perform. But the reward was commensurate. At the age of thirty-one, Wargentin was elected corresponding member of the Paris Academy of Sciences, and member of the Swedish Academy of Sciences, and of the Uppsala Scientific Society, all within one year. The following year he was elected permanent secretary of the Swedish Academy, and thereafter until his death, a third of a century later, the story of his life is very largely the history of the Academy.

At that time the Academy was only ten years old; it will be recalled that its bicentenary fell last year. For two years it had enjoyed the monopoly from the sale of almanacs, but the revenue from this source was only modest, and it was charged with the erection of the Observatory at Stockholm. Under the management of Wargentin the yield from the monopoly was almost trebled within a couple of years. By this means progress with the Observatory, of which he was to be the first director, was advanced; it was inaugurated in 1753. Even while it was unfinished he had continued his observations, and afterwards he obtained the necessary funds to add a quadrant by Bird and other instruments to the equipment of the Observatory. Outside what must be considered his life-work on Jupiter's satellites, Wargentin's contributions to astronomy were chiefly in the field of parallax research. When Lacaille went to the Cape of Good Hope in 1750 to observe the moon and Mars, Wargentin made corresponding observations himself at Stockholm, and organized four other stations in Sweden. Similarly, he organized observations in addition to his own of the transit of Venus in 1761 and 1769. Thus his astronomical work was by no means confined to one special field.

But it was there that he made his reputation by his indefatigible researches. As a means of attack on the longitude problem, the eclipses of the Jovian satellites had attracted early attention. The first tables were made by J. D. Cassini (1668, revised 1693). Bradley's uncle, James Pound, published new tables in 1719, and Bradley himself contributed a new version to Halley's "Tabulæ astronomiæ" in 1749. So it would appear from this passage (pp. 327–328): "Sans doute Halley publia-t-il dans ses Tabulæ astronomiæ de 1749 des tables remaniées par Bradley et dues plutôt à son oncle Pound. Halley n' avait naturellement pas encore connaissance, à cette époque, des tables de Wargentin qui se montrèrent bientôt supérieures à celles de Bradley." But this cannot be accepted as fair comment, for the simple reason, of course, that Halley died in 1742. In fact, Bradley's "Corrected Tables", which were published as stated in 1749, were finished in 1718, when he was barely twenty-five and was serving that apprenticeship with Pound during which it would be probably hard to distinguish clearly between the work of uncle and nephew. It may be surprising that these obsolete tables were included in the 1749 edition of Halley's collection, but it was most natural that ten years later Lalande substituted Wargentin's revised tables in his Paris edition of the same

collection. The observations were continued, and the tables were revised from time to time until they reached a state of perfection which was truly admirable. For they were scarcely surpassed, as de Sitter ascertained, by Delambre's tables of 1792, which were founded on the dynamical theory of Laplace, whereas the earlier method had been purely empirical. This process has been compared with Kepler's, but a closer analogy may be seen in the lunar theory of Horrocks, and Wargentin's success in isolating the main inequalities in the motions of the satellites was quite remarkable. As this work has met with the fullest recognition it was scarcely necessary to dispute (pp. 205, 327) Bradley's priority in noting the commensurable relation connecting the mean motions of the three inner satellites. Wargentin was fortunate in finding a task in astronomy exactly suited to his powers, and he carried it out admirably.

To this account of his astronomical work it should be added that besides the observations made on every possible night he initiated a routine of meteorological readings by day, the beginning of a continuous record to the present time. No assistant is mentioned, and he seems to have worked single-handed throughout.

But Wargentin the astronomer was only half the man, whose capacity for work must have been prodigious. As secretary of the Swedish Academy, then in its infancy, he developed all the activities which can be expected from a national academy. In general such duties devolve on a considerable number of individuals, but Wargentin combined them in his own person. He was secretary, editor of the publications, treasurer, foreign secretary and librarian all in one. In no respect did the interests of the Academy suffer from this concentration of functions ; on the contrary, it prospered in all departments. His success in nursing the revenue from the sale of almanacs has already been mentioned. He cultivated foreign correspondence with special ardour in addition to the domestic exchange of letters. As a result the Academy possesses more than 4,000 letters addressed to Wargentin, and it may be interesting to select a few names : Jean Bernoulli (40), A. v. Haller (45), Max. Hell (15), Lacaille (10), Lalande (38), Lexell (111), Linné (124), de l'Isle (20), Maskelyne (5). There is even a letter from Marat, dated 1779. Apart from this, the sample selected naturally reflects in the first place Wargentin's high position in the astronomical world.

The functions of a national academy are not confined, however, to its own affairs or to its foreign relations. It has many opportunities to offer advice to Government in the interests of the country, and such advice often involves great labour. When the Gregorian calendar was introduced in 1753 Wargentin played an effective part in recommending the change. This was appropriate to his professional character. More remote was an active share in the commission directing work on the Trollhättan Canal. Still farther afield was service on a commission to translate the Bible, where his special concern was with biblical chronology. But Wargentin had enjoyed the advantages of a wide liberal education in his youth. He could turn a set of Latin verses, though whether they would have satisfied the critical taste of Bentley better than Halley's may be doubted.

In 1769 Wargentin received the royal commission to construct a map of the Swedish coast. The work was unlike Halley's on the English Channel in the *Paramour Pink* because the observations had already been made. In this case the task proved too much for an overburdened man and it was relinquished within two years in an unfinished state. But one interest persisted through life and constitutes a second high claim to recognition. So early as 1736 the Swedish Government was taking an interest in vital statistics. This was fostered by the Academy and the new secretary soon took a leading part on an expert committee appointed by Government. The outcome of Wargentin's researches and reports was the creation of a permanent organization in 1756 which is said to have been the first of its kind in the world. From the data collected in the following years he formed tables of mortality which marked a great advance no doubt on previous knowledge, though the claim that they were the first to be based on exact data rather overlooks the "Breslau Tables" of Halley. The Swedish results met with the warmest reception from Richard Price, whose opinion of them may be quoted : "These observations are more curious than any that have been yet published, and leave us little to wish for on this subject, except that similar observations were made in other kingdoms under direction of men equally able and ingenious with Mr. Wargentin". Through Price they must have exercised an influence on British actuarial practice. In Scandinavian countries Wargentin laid a foundation the effect of which is still visible in the theory and applications of statistical science, so keenly cultivated in that region of Europe.

The author of the present memoir has drawn the portrait of his subject perhaps a little larger than life-size. With every discount, a very considerable figure emerges who was not only eminent in his own small country—according to his own estimate the population of Sweden was little more than 2·3 millions—but also a man of real distinction in the larger world of eighteenth-century science.

H. C. PLUMMER.

RECONSTRUCTION AND TOWN AND COUNTRY PLANNING

THE widespread destruction of property in the Greater London area which has attended the air raids of recent weeks should have brought home to everyone both the need and the opportunity for reconstruction which have come. The appointment of Sir John Reith, who is being made a baron, to the new office of Minister of Works and Buildings and First Commissioner of Works, suggests that the Government recognizes officially the magnitude of the task which lies ahead. So long ago as November 1939 an admirable paper by W. Braxton Sinclair on A.R.P. in town planning before the Air Raid Protection Institute indicated some of the possibilities in this direction if realistic and rational planning receives the executive authority to ensure that the plans are given appropriate effect.

The reconsideration of the planning of London in the light of civil defence is, however, only one point of view which needs attention before reconstruction is undertaken. Other important factors were indicated in the P E P (Political and Economic Planning) report on the location of industry and have since been reiterated in the report of the Royal Commission on the Geographical Distribution of the Industrial Population. Attention has recently been directed to the importance of this report by Lord Balfour of Burleigh, chairman of the 1940 Council, appointed by a conference of the Royal Institute of British Architects in February of this year for the promotion of the planning of social environment.

The conference in question was called to consider what immediate action could be taken to promote, through research groups or by other means, the planning of social environment on a national scale and to make more widely known the need for such planning. The work of the Council thus involves both research and publicity, and its activity in each field will be largely dependent on interested societies, the co-operation of which will be sought in their special fields of work. Lord Balfour has emphasized the way in which planning for post-War conditions must start from the recommendations of the Report of the Barlow Commission, and has also indicated the Council's general agreement with nine agreed points of principle reached by the Royal Commission. Beyond this, however, the Council recommends further investigations in a number of directions, particularly as there appears to be no immediate prospect of the proposed national board being established.

Among these new directions for investigation as a prelude to reconstruction are the problems raised by evacuation and the dispersal of industry, through the development in rural areas and elsewhere of immense war industries and undertakings. There are also the problems already mentioned arising from the destruction of buildings by aerial bombardment, and those of planning for demobilization so as to have ready for immediate operation a long-term constructive programme to bring hope and inspiration to a war-weary people, millions of whom will see their war occupations coming to an end. Lord Balfour rightly suggests that such problems may well call for a different type of national board from that envisaged by the Royal Commission, and that in view of the extent to which the winning of the War demands almost the entire attention of the Government, the preliminary research and thought should be devoted to these problems by a voluntary body such as the 1940 Council.

There is ample evidence that Lord Balfour of Burleigh's initiative is not premature, even if we are at the height of a life-and-death struggle. Valuable, however, as the efforts of an unofficial body may be, there are several reasons for doubting whether anything short of an official body will be adequate even for the preliminary work. For one thing, apart from the fairly considerable amount of research that will be required, the whole course of the War demonstrates the difficulty of predicting its termination with any exactitude. The fundamental lines of our planning can scarcely be determined too early if they are to be ready against an unexpectedly early termination of hostilities, the demands of which are likely to be no less searching than at the end of a prolonged struggle. Moreover, as the War proceeds, the problems in which immediate action affecting post-War policy and planning are imperative multiply. Not only does it frequently happen that the wisest immediate policy is that in line with long-range requirements of reconstruction, but also in the absence of such foresight fresh obstacles may be created or allowed to grow up in the way of the planning required on a national scale after the War.

The whole experience of the War of 1914–18 goes to show indeed that planning for reconstruction during a war is essential. The Ministry of Reconstruction which was created in August 1917 was actually the successor of a Reconstruction Committee appointed much earlier by Mr. Asquith

when still Prime Minister. The great value of the plans prepared by the Ministry before the Armistice is often obscured by the difficulties which appeared in 1920. Much social legislation of which we are now justly proud was embodied in those plans. While other projects encountered heavy weather either temporarily or permanently, it is quite clear that but for the work of the Ministry of Reconstruction our post-war troubles of 1919 onward would have been even more serious. So far from the formation of the Ministry being premature the evidence is rather that it was not initiated early enough for all the complex problems involved to be investigated adequately before it was necessary to formulate policy and take action.

The scope of the work and duties of the Ministry of Reconstruction as conceived after some six months work are well worth recalling at the present time. A statement issued to the Press for a meeting on January 24, 1918, indicates that the Ministry embraced branches dealing with commerce and production, including the supply of materials; with finance, shipping and common service; with labour and industrial organization; with rural development; with the machinery of Government, central and local, including health and education; and with housing and internal transport. The Ministry as a whole and the several branches in particular were concerned with the study of all proposals for dealing with post-War problems, whether under consideration by Government departments or committees or advanced by responsible bodies or persons, and with the development out of this material of a reasoned policy of reconstruction in all its branches. An advisory council, representative of all the leading interests concerned, had already been created by the Minister, organized in four sections on similar lines, and the statement indicates that in certain fields inquiry had already reached a surprisingly advanced stage.

Much of the work which was done then is clearly available for our guidance in the situation confronting us to-day, but whether or not the many investigations which are still required are prosecuted under private or Government auspices, the importance of some co-ordinating Government department charged with the prime responsibility for reconstruction can scarcely be denied. Already the difficulties in regard to relief accommodation and transport, the provision of shelters and the organization of evacuation of non-essential classes from threatened areas have indicated the need for some single supreme authority to deal with these problems in respect of London alone. Such an authority is needed partly to prevent confusion through divided responsibility or inadequate local resources in individual boroughs. Much more, however, the need is for inspiration and leadership and the power to cut through any network of 'red tape' or private interest that may stand in the way of swift emergency provision for the homeless or distressed, or the organization of shelters and transport services so as to secure the maximum possibility of sleep for London's workers.

If a leader of the right type could be found for such a post and given the sweeping powers essential, he could give new spirit and purpose to the whole work and quickly win the eager co-operation of the public. Nor should the effect be confined merely to relief of the immediate strain that the people of London are enduring. The disappearance of difficulties that at present seem formidable in the immediate situation would be of immense value also in dealing with reconstruction after the War, and leadership of the type visualized would supply exactly the right drive and direction required in the approach to problems of reconstruction during the War.

What seems to emerge from a review of the work and achievements of the former Ministry of Reconstruction is first that the educational work in preparation for reconstruction was insufficiently thorough and widespread, and secondly, that without disparaging the vision displayed by the Ministry, the importance of co-ordination and the extent to which problems of reconstruction are interlocked was not sufficiently realized. The first of these functions is one that the 1940 Council has undertaken to serve, but the second is undoubtedly one for the Government itself. Moreover, it cannot be expected that all the fundamental research which is required as a basis for planning can wisely be left to individual initiative. Government support and direction are required if only to see that resources are allocated to such effort as part of our national War effort, and in due proportion with other demands.

It is true, of course, that in some directions research is already proceeding under Government auspices, for example, under the Building Research Board, which is of direct importance to post-War planning although inspired by immediate requirements. Much more is possible in this way if only we are awake to our opportunities. For example, it has been pointed out how in the planning of a new city the incorporation of an appropriate green belt can be made to fulfil a military need to enclose and limit the city boundaries and provide dual encircling road communications with ample scope for the provision of aerodromes, anti-aircraft gun positions, searchlight stations and the like, and also accord with the principles of good civil planning. Similarly, in the provision of perfect road communications the military requirements

coincide in the main with the civil needs of the population.

While it is true that in town planning, as well as in regard to building, we need principles which have been reached as a result of scientific research, it should not be forgotten that in particular scientific fields a firm scientific basis is already available as a basis for policy. What is required in the matter of sunlight incidence, for example, as pointed out by Mr. Thomas Sharp in his excellent little volume on "Town Planning" in the Pelican series, is appropriate action on the facts already ascertained. The most disturbing feature of the whole situation is indeed just the shelving by the Government of the Report of the Barlow Commission.

It cannot be too strongly insisted that unless the long-term problems involved in the location of industry, evacuation, and national defence are faced now, formidable and perhaps unsurmountable obstacles may be placed in the way of the scientific use of our resources and of post-War reconstruction. Town and country planning have acquired a new importance, and the formulation of a national policy is imperative.

For this reason alone Mr. Sharp's little book deserves widespread attention. It is not merely that he directs attention to the dangers attending a policy of drift or to the essential unity of town and country planning. He stresses the need for a clearly thought out and well-defined policy, but the greatest value of his book may well lie in the revelation it will bring to many of the opportunities which clear vision and determined policy can put within our reach.

It is indeed important to remember those opportunities in view of the triviality and narrowness of some of the aims of our statutory town and country planning, its inadequacy or ineffectiveness, particularly on the larger issues, in face of the rights of private property, and the inadequacy of the agents to which such planning has hitherto been entrusted. It should be remembered, moreover, that the English contribution to the art of building towns was once an original and a valuable one, while its achievement in the countryside in the eighteenth century, as Mr. Sharp points out, was one of the most successful creations of its kind in the contemporary world.

The knowledge of the way in which the opportunities for improvement which changing conditions offered was taken by our eighteenth century forefathers should be an inspiration to us amid the even greater opportunities of to-day. If we vigorously seize them, snatching from them every possibility of doing our work in the finest instead of the easiest way, we may not only find new forms of expression worthy of the new materials and new powers with which science and technical advance have endowed us, but also, in so doing, once again build towns that will be worthy of us, possessing beauty and order and all the facilities for the living of that good social and physical life which it is the prime purpose of the town to provide.

Simultaneously, the opportunities in the countryside must be recognized and used. The preservation of the countryside must be recognized as a dynamic, not a static, ideal. The countryside is not merely scenery; it is a place of industry as much as is the town, a place of social and economic activity. It is a living organism to preserve which is merely to kill it.

No less in the countryside than in the town, we can if we will use the opportunities of social and economic change for the creation of new beauties and new possibilities of happiness. Already the problems encountered in evacuation have indeed shown how much might yet be done to make an even finer countryside in which, beside the harmony of all its constituents in a sympathetic relationship to each other, making a splendid whole which was the feature of the past, we have among those constituents the facilities necessary to enable the great new inventions to confer their immense benefits upon the countryside as well as on the town. Besides this, the exploration of agricultural policy in regard to food supply and health may well lead to new lines of development, to changes in the use of the land which have to be integrated into a national rather than a departmental policy if we are to reap their full benefits.

It is well that the opportunities which are before us should be so clearly indicated, and the extent to which we can, if we will, seize them while still prosecuting our War effort with all the energy at our command. Our environment will be modified by new forms of knowledge as well as by the demands of national defence or the consequences of enemy action, whether we consciously use that new knowledge in planning or not. The full advantages of social and economic reconstruction can only be secured if we embark now on the necessary planning and the investigations on which such planning must be based. If we attempt at once to take full account of the impact upon town and country planning and social conditions of the revolution in means of communication, and so plan the utilization of our resources for national defence that post-War reconstruction is kept clearly in mind, it should be possible to avoid many sacrifices of the requirements of peaceful living, to promote that educational process which must precede social reconstruction and to foster much of the scientific research which will supply the basic data alike for the purposes of total war and for the reconstruction to follow.

THE PROGRESS OF CAMOUFLAGE

IN NATURE of June 22, there appeared a leading article in which the camouflage organizations of Great Britain were severely criticized for not making sufficient use of scientific men and scientific principles.

As evidence of the way in which the scientific spirit is, however tardily, coming into its own in the conduct of the war, the following impressions of a visit to the headquarters of the Civil Defence Camouflage Organization may be of interest.

This is the largest central organization devoted to camouflage, and forms part of the Research and Experiments Department of the Ministry of Home Security, to whom Dr. R. E. Stradling is the chief adviser. The experimental work is under the direct supervision of Prof. W. E. Curtis, assisted by a technical staff which includes artists, engineers, architects, chemists, physicists, photographers, and a botanist. All the work is studied as an air problem. The sites and buildings to be camouflaged are first viewed and photographed from the air. If they are of major importance, a model is then made and camouflage applied to it. It is inspected in a special viewing room, where a turntable and a movable light provide varied conditions of illumination; and also out-of-doors from a greater distance. After the model has been, if necessary, corrected, and a colour photograph taken of it, the camouflage scheme is then applied to the actual site, which is then again viewed and photographed, this time in colour, from the air; and any final corrections required are then made. In the case of smaller buildings or those which offer less difficult problems, the model is dispensed with, and its place is taken by a two-dimensional sketch of the camouflage scheme.

One of the criticisms made in the earlier article was that biological principles were being largely disregarded. This certainly does not apply to the present work of the Civil Defence Camouflage Organization. What the biologist calls general resemblance, special resemblance, disruptive pattern, deflection, and mimicry are all now being employed as the situation dictates.

General resemblance is more commonly employed in military camouflage in the field, where mobile objects are coloured so as to be as inconspicuous as possible against a variety of surroundings. Special resemblance to particular natural objects is often extremely ingenious. Admirable methods of counterfeiting grass are now available, and artificial woods with 'sapless foliage' but permanent greenery spring up where required. Sham buildings, worthy of a film set, may be used to disguise landmarks.

In biological mimicry of the typical or Batesian kind, a harmless organism evolves so as to counterfeit the appearance of one better protected against enemies than itself. The reverse is true in mimetic camouflage: an object of military importance, such as an armaments factory, is disguised to resemble a non-military objective. Some of these schemes are most successful.

In biological deflection, the attack of an enemy is drawn away by conspicuous pattern from a more vital to a less vital part of the body, or from a biologically more important individual (such as a brooding duck) to a less important one (such as the drake, the racial function of which is over for the year once he has fertilized the eggs). In a similar way, false targets may be employed in war to draw attack away from real ones: without giving away vital secrets, it may be said that some of the deflection methods now employed are both ingenious and effective.

Disruptive pattern, however, when all is said and done, is the most essential tool of camouflage for large stationary objects such as buildings; and this is now being employed to extraordinarily good effect. One of the earlier criticisms was that the pattern used was on too small a scale to be effective against air attack, but this no longer holds, and remarkable illusions are produced.

Another criticism made in the earlier article was that structural methods were being neglected, and undue reliance placed on paint, which by itself is often helpless to disguise shadows and hard outlines. This was true to some extent during the early months of the War, but to-day (though not until after a struggle) various structural devices are being utilized on a large scale, and a special engineering section has been formed in the camouflage establishment to deal with the unfamiliar and troublesome problems involved in their proper use.

Yet another criticism was that the work was entrusted too exclusively to artists. The experience of the Civil Defence Camouflage Station is that artists are indispensable for design, both because of their gifts of observation and for their capacity to see and memorize a site in terms of colours and tones instead of in terms of objects of human significance, and also because of their technical knowledge as executants. But their work is carried out under the supervision of the

physicist in charge, so that art is constantly guided and checked by science.

It must not, however, be supposed that perfection, scientific or otherwise, yet reigns in the camouflage world. In the first place, the Civil Defence Station is only one, albeit the largest, of the various organizations dealing with the problem. In addition, there is a large amount of private property not regarded as of sufficient importance to justify official action. In practice, however, owners of such property are consulting the Station in increasing numbers, with the result that there will be fewer unscientific monstrosities such as the cooling cylinders, mentioned in NATURE of June 22, the white surface of which was adorned with naturalistic trees.

Not all the different organizations are as yet equally scientific or efficient, and in some cases, notably ships at sea, far too much use has been made of the anti-scientific principle of uniformity of colour and tone, which gives the most conspicuous possible pattern.

In addition it would appear that in some quarters camouflage has become a sort of fetish, implying the application of green and brown blotches of one or two feet in diameter, whatever the object to be disguised and whatever its surroundings. But here, too, the situation is improving.

Then, as may be imagined, co-ordination and central direction are difficult so long as we have numerous separate organizations which, starting independently, tend to preserve their independence. Something, however, has been done to remedy this, by means of a new co-ordinating committee, attached to the Civil Defence Camouflage Station, but containing representatives of other organizations, both official and non-official.

But the most important enemy of efficiency has been delay—delay between the completion of a scheme and the beginning of the application of paint to the actual building, delay which may involve several wasted months. In part this would appear to have been due to official regulations and methods of working, in part to carelessness or inefficiency on the part of the private firms the buildings of which are being camouflaged, or of the firms undertaking the actual camouflage.

Another trouble is the habit of regarding camouflage as something you put on to a building when it is completed. The notion that it would be much easier and cheaper, and much more likely to achieve really good disguise, if buildings were designed from the outset in relation to the problem of their camouflage, has scarcely entered the mind of authority or of builders. Buildings of the utmost regularity, and therefore extremely difficult to disguise, still continue to be erected, simply because that is the recognized pattern for buildings for that particular purpose.

Photographs of one of the few buildings which has been designed from the outset in co-operation with camouflage experts make one realize what could be achieved. The huge structure is part of the English landscape, complete with fields, woods, roads and hedges, and is as nearly indistinguishable as could be imagined.

The camouflage services inevitably suffer from the high cost of many of their schemes, the shortage of supplies, and the fact that camouflage is low on the list of priorities. It is clear, however, that in spite of a slow start, the art of camouflage has in the last six months gone far in utilizing scientific knowledge and scientific methods.

J. S. H.

OBITUARIES

Sir Harold Carpenter, F.R.S.

Sir (Henry Cort) Harold Carpenter, professor of metallurgy in the Royal School of Mines, London, whose death at the age of sixty-five occurred on September 13, was regarded as the leader of the metallurgical profession in Great Britain. He came from a family which produced several distinguished men, and in view of his career it is particularly interesting that one of his great-great-grandfathers was Henry Cort, whose inventions did so much to establish the position of England at the head of the iron industry in the eighteenth and nineteenth centuries. Carpenter, however, was not originally trained as a metallurgist. He studied chemistry at Oxford and Leipzig, and became research fellow and demonstrator in Owens College, Manchester.

When the National Physical Laboratory was established in 1902, Carpenter was appointed to take charge of chemical and metallurgical work. The choice was fully justified by the production, in a very short time, of several important researches, the chief of which was the determination, with B. F. E. Keeling, of the range of solidification and the critical ranges of the iron-carbon alloys. Although much work has since been done on this system, the latest determination confirms the essential accuracy of their results, other investigators having been less successful in obtaining equilibrium. The aluminium-copper system was examined with similar minute accuracy, while other papers dealt with the heat treatment of high-speed tool steels and with complex alloys of iron—a remarkable output for the early

days of a new institution with very limited staff and equipment.

In 1906 Carpenter was appointed to the chair of metallurgy in the Victoria University of Manchester, and in 1914 he moved to the Royal School of Mines, after a tour of metallurgical centres in the United States with the object of seeing industrial smelting processes at first hand. Under his guidance both these laboratories became active centres of research. Besides the determination of the equilibrium diagrams of binary and ternary alloy systems, and studies of the growth of cast iron, his work dealt largely with the growth of metallic crystals after mechanical strain. In this way, as the result of a series of well-planned experiments, he was led to the study of single crystals, and this new method of preparation proved to have many advantages over that of solidification from the melt. Partly with collaborators, he undertook a thorough examination of the modes of deformation of single crystals, and thus opened up a new and very important field of research. His interest in the processes by which metallic structures are formed was further shown by a series of papers in which the mode of separation of ferrite and pearlite from austenite in steels was studied in detail, and by an investigation, illustrated by beautiful photo-micrographs, of the structures of native copper and silver.

Carpenter was an admirable teacher. He had the faculty of interesting his students, who always held him in the greatest respect and affection. His courteous manner and wide interests made him an excellent chairman, an office which he held in the Metallurgy Research Board and the Gas Cylinders Committee, among other bodies. He had the unique distinction of having occupied the presidential chair of all three of the institutes connected with his science: the Iron and Steel Institute, the Institute of Metals and the Institution of Mining and Metallurgy. To all of these he gave devoted service. When, in 1929, the Treasury set up a committee to inquire into the position of scientific staffs in Government departments, he was appointed chairman, and the "Carpenter Report", with its far-reaching recommendations, has served as the charter of the scientific side of the Civil Service. The tact of its chairman had much to do with its success. In later years his services were more and more called upon as an adviser on matters of scientific administration.

When war broke out in September last, the Metallurgy Department of the Royal School of Mines was transferred to Swansea, where professor and students found a congenial home with Sir Harold's former assistant and collaborator, Principal C. A. Edwards. Shortly before, with Dr. J. M. Robertson, he had completed a book which had been long in preparation, and forms an enduring monument of his work. This two-volume treatise on "Metals" covers an extraordinarily wide range, from crystal structure to industrial processes. In spite of its size, it has nothing of the encyclopædia in its character, but is a clear and most readable survey of the field of metallurgy, accurate in detail but never allowing the main lines to be obscured. Only the unavoidably high cost of so large a book prevents its more extensive use by students.

Many honours came to him. He was elected fellow of the Royal Society in 1918 and knighted in 1929. He received honorary degrees from the Universities of Wales and Sheffield and was a corresponding member of the Royal Swedish Academy of Science and of the Société d'Encouragement, and an honorary member of the American Institute of Mining and Metallurgical Engineers. He was awarded both the Bessemer and Carnegie Gold Medals of the Iron and Steel Institute, the Institution of Mining and Metallurgy and the Thomas Turner Gold Medals, the Carl Lueg Gold Medal of the Verein deutscher Eisenhüttenleute, the Platinum Medal of the Institute of Metals and, only this year, the Honda Gold Medal of the Japanese Institute of Metals.

Lady Carpenter, formerly Miss Ethel Lomas, was his devoted and constant companion, and in acknowledging the award of the Bessemer Medal, he paid tribute to her constant support and aid in his work. Mr. Headlam-Morley's account of him in *The Times* of September 26 gives a striking picture of the impression which his personality and character made on his many friends. He was a lover of walking and of the mountains, and had seemed to be well in health, but although there were no external signs of arterial disease it was well advanced and his death from heart failure occurred while on a country walk near Swansea. C. H. DESCH.

Mr. F. Hutchinson

IN the death on April 6 of Francis Hutchinson, New Zealand loses one more member of that distinguished band of naturalists who were the forerunners of present-day scientific research in that country. He lived during the period which saw the transition from the pioneering work of Colenso, Haast, Hochstetter and others to the present age of specialists and research laboratories, and like his friend Guthrie-Smith (whose death was recently recorded in NATURE) most of his studies were made in the field.

Hutchinson was for some years editor of the *East Coast Naturalist*, a pioneer journal conducted in manuscript, and occupying a unique place in the scientific literature of New Zealand. He also contributed occasionally to the *Transactions of the New Zealand Institute*. He will, however, be chiefly remembered for the moulding influence he exerted on many of the present-day generation of research workers of his country; he had a genius for expressing the facts of Nature in language calculated to stimulate the imagination of the boy, and the number of younger scientific workers who owe their first teaching to him is itself a tribute to his memory.

A few years ago Hutchinson presented to the nation a tract of virgin forest at the foot of the Birch Mountains for preservation as a scientific reserve. Mrs. Hutchinson, who survives him, was his companion on many naturalist expeditions in the mountains of Hawkes Bay, and is at present engaged on a study of the lichen dyes of New Zealand.

H. BARRACLOUGH FELL.

NEWS AND VIEWS

Science and the National War Effort

In order to ensure the continuance of the fullest co-operation of scientific workers with the Government in the national war effort, the Lord President of the Council, after discussion with the Royal Society, has, with the approval of the Prime Minister, appointed a Scientific Advisory Committee with a secretary from the Cabinet Secretariat. The terms of reference of the committee are: (a) to advise the Lord President on any scientific problem referred to them; (b) to advise Government departments, when so requested, on the selection of individuals for particular lines of scientific inquiry or for membership of committees on which men of science are required; (c) to bring to the notice of the Lord President promising new scientific or technical developments which may be of importance to the war effort.

The members of the committee are: Lord Hankey, G.C.B., G.C.M.G., G.C.V.O., chancellor of the Duchy of Lancaster (chairman); Sir William Bragg, O.M., K.B.E., president of the Royal Society; Dr. E. V. Appleton, F.R.S., secretary of the Department of Scientific and Industrial Research; Sir Edward Mellanby, K.C.B., F.R.S., secretary of the Medical Research Council; Sir Edwin Butler, C.M.G., F.R.S., secretary of the Agricultural Research Council; Prof. A. V. Hill, O.B.E., F.R.S., M.P., secretary and Foulerton research professor of the Royal Society; Prof. A. C. G. Egerton, F.R.S., secretary of the Royal Society and professor of chemical technology in the Imperial College of Science and Technology.

Social Survey of Tyneside

In "Tyneside: the Social Facts"(Newcastle-upon-Tyne: Co-operative Printing Society, Ltd., 1940. 1*s*.) Mr. D. M. Goodfellow gives the results of a session's work of a tutorial class organized by the Workers' Educational Association in Newcastle-upon-Tyne, which shows the effects of the depression in Tyneside. A short summary is given of the death-rates from tuberculosis, pulmonary and non-pulmonary, in the Tyneside area which shows that the Tyneside districts in 1917 showed increases for the most part much greater than in corresponding districts throughout the country, while by 1921–25, the reduction in the incidence of tuberculosis was far less than in the whole country, except for one town; although the position improved by 1935–37, the improvement was appreciably less than in England and Wales as a whole. These high tuberculosis rates, in spite of a relatively high standard of public health services, much superior to that of the Welsh areas, is attributed to the effects of a false prosperity which reached its apex during the War of 1914–18 and weakened Tyneside's resistance in the long depression that followed, overcrowding and large families rendering the area specially vulnerable.

Children and Poverty

Mr. Goodfellow accordingly points out that sanatorium treatment of tuberculosis must be followed by real enterprise to remove the poverty of the patient. Infant mortality figures confirm this effect of the last war on Tyneside. In 1911–13, Newcastle, Tynemouth, South Shields and Gateshead were all below the infant mortality average for English county boroughs. By 1914–16, as a result of increased industrial effort without proper safeguards, these four Tyneside boroughs had infant mortality rates much higher than English county boroughs as a whole and while from 1911–13 to 1935–37 in the country as a whole infant mortality was reduced by practically 50 per cent, the Tyne black spots showed no such improvement. These figures again are related to overcrowding. In 1925, one baby in three in Tynemouth was born in a one-room apartment, and even in 1933 one baby in five suffered this fate although in 1938 the rate had fallen to one in 20. The figures are again related to the work of infant welfare centres. In Leeds, for example, with an infant mortality rate of 64 per 1,000 births, the rate fell to 21 among babies attending the clinics.

Mr. Goodfellow's review of the maternity and child welfare centres on Tyneside shows the variation in the provision for such services made in very similar areas and emphasizes the need for radical reorganization of local government services taking account of the needs of all types of district. Similar variations or discrepancies occur in the school medical services, in the provision of school meals, milk, or for defective children. During the past few years Tyneside and Durham have fallen further behind other districts in regard to malnutrition of school children, even by present methods of assessment the percentage of under-nourished children being more than three times as high in Tyneside and Durham as it is in London and the south. Equally wide variations occur in the Tyneside districts in regard to the percentage of elementary school children leaving school at the age of 15 or over, although it should be noted that in five years Tyneside has lost more than 15 per cent of its elementary school children.

Civic Authority and Social Development

The local rates show the same wide fluctuation, and Mr. Goodfellow points out that if civic conscience is to be developed, Newcastle, Gosforth and Whitley Bay and Monkseaton must enter a unified Tyneside and give it the benefit of their rateable value. The attitude of mind which has allowed business people to reside in Gosforth on profits made out of Jarrow or Felling or Hebburn, while disowning all responsibility for even the barest minimum of decent existence in Jarrow, Felling or Hebburn is utterly inconsistent with civic decency. Mr. Goodfellow

considers that the new region should also include Durham, partly to avoid Tyneside, as an industrial region, being swamped by a conservative and agricultural county, which has not yet shown itself to possess industrial standards in its social services, and partly because of Durham's achievements in the development of such services, and he also points out the example set by some of the districts such as Felling in changing their character from a slum-ridden overcrowded little town to one of the best garden cities in the country. If such districts lose control of their own civic life the division of powers between local and regional authorities will require the closest consideration to avoid friction or deadlock, and Mr. Goodfellow advocates the transfer of control of all services and ownership of all public utilities to the regional authority as most conducive to social development.

Conflicting Ideals and War Aims

ON the outbreak of war, the -ologies and -isms into which the world of European civilization had been divided since the irruption of the dictator into national and international politics were resolved into an opposition of Christianity over against paganism. Such at least has been the rallying cry with which Britain, in what may be termed her official proclamations, asks for and has received the moral and material support of the members of the British Commonwealth of Nations, the United States of America and the remaining free peoples of the world. It must be patent, however, that in the present stage of development of modern thought, a literal interpretation of this bond as a subscription to a theological formula, as would seem to be implied, would set outside the pale not only those who are members of the other great religious systems of the world, but also those who, while intellectually 'non-jurors', have entered upon the struggle to secure the ascendancy in world affairs of that spirit which inspires Christianity, but is not peculiar to it, with a fervour and passionate devotion which has all the intensity of religious emotion. To say this is not to imply a revival of the over-long opposition of religion and science. It is rather to emphasize what has been in fact an approach to composing their differences ; but there are not lacking those who in the cause of intellectual integrity would prefer to clarify the issue and to rest upon a statement of our aim in its simplest and widest appeal as being alone acceptable to those who adopt the point of view of the rationalist.

Such a line of argument is set out, for example, by Mr. A. Gowans Whyte in "Make your own Religion" (The Thinker's Forum, London, Watts and Co., 1940. Pp. 47. 6*d*.). After passing in review the evidences of the failure of Christianity—unkindly drawn in part from the utterances of the Churches themselves—and the bankruptcy of a Christianity which alternatively depends upon a few generalized moral principles, Mr. Whyte sets out on "an adventure" towards a new religion, a religion which is "a search for the truth" and "the satisfaction of the will to know" as opposed to "the will to believe". The object of this "will to know" is the building up of a picture of the universe and man's place in it in accordance with the doctrines of evolution. Christian morality, it is argued, is not far and away superior to all other codes as the Divine law, but is as imperfect as those other codes and is subject to change in form from time to time and from place to place. The ideal on this view—a moral system which enables the individual to live "a full mental, emotional and physical life in harmonious association with others equally blessed"—is, it is admitted, still a long way ahead, but progress will depend upon knowledge of the moral evolution of mankind and upon a mind set free "to learn, to probe, no doubt, to reject, to accept, as experience and reason suggest"—in other words upon the principle of freedom of thought for which really we are fighting.

Additions to the British Flora

ALTHOUGH only an infinitesimal proportion of the alien plants which reach Great Britain in some form or other and take root ever succeed in establishing themselves, much less colonizing the country, a small number of additions to the flora that have established themselves in recent years from garden escapes or alien casuals of industry may have some important bearing upon the flora of the future. In 1928, F. W. Holder and R. Wagstaffe, of the Southport Scientific Society, found an alien composite with small yellow flowers at Freshfield, West Lancashire (vice county 59, botanically "South" Lancashire), which Druce afterwards identified as *Siegesbeckia orientalis*, fairly widely distributed in the southern hemisphere, but not previously recorded in Britain. In the twelve years since then, the species has firmly established a colony of plants at the Freshfield station and J. D. Massey, in a communication to the Liverpool Botanical Society, has pointed out that it differs from Ridley's description of the species in the "Dispersal of Plants Throughout the World" in growing much taller (5–6 ft.), in always possessing five long narrow bracts instead of four, and has glands on the leaves and stem as well.

About the same period, R. E. D. Baker discovered *Scirpus americanus* (Pers) by a slack on the Freshfield dunes, its only other European station being on Jersey, although W. G. Travis had an unnamed 1909 specimen from the same Freshfield site in his herbarium. Since then, the colony of *Scirpus americanus* has considerably extended on the site to about half an acre, and J. D. Massey has successfully transplanted a second colony 100 yards south. The steady colonization of the countryside by such Petasites garden escapes as the winter heliotrope and white butterbur (*P. albus*) may be emulated by another white butterbur, *Petasites japonicus*, which was recently added to the Cheshire flora (Eric Hardy, *J. Bot.*, April 1940). Wilson has noted it in Lakeland ("Flora of Westmorland"), and the former record elicited specimens in the British Museum herbarium from additional stations at Denham and Langsdale, and elsewhere from Denbighshire (*Field*, August 28).

Engineering in the University of Glasgow

In less troublous times professional engineers all the world over would undoubtedly have wished to collaborate in celebrating the centenary of so important an event as the founding in 1840 of the regius chair of civil engineering and mechanics at the University of Glasgow. The second occupant of the chair, Prof. W. J. Macquorn Rankine, was an exceptionally brilliant man to whom all fields of knowledge seemed alike, and there are few branches of engineering science to which he did not make some notable contribution. In his time there was no thought of the expansion that was soon to take place, which now makes separate subjects of civil, mechanical and electrical engineering. As *Engineering* of September 27 points out, he was also an accepted authority on naval architecture. His influence was, and still remains, potent in many branches of design. The *Glasgow Herald* of September 16 says that he was "the first really powerful thinker in this country to bring the highest mathematical resources to bear on engineering practice".

Rankine died in 1872 and was succeeded by James Thomson, brother of Lord Kelvin, who was one of the earliest to develop the large-size centrifugal pump. In 1889 he was followed by Archibald Barr, who will long be remembered for his collaboration with Dr. Stroud in the production of the Barr and Stroud range-finder. He also left an enduring monument in the James Watt Engineering Laboratories of the University which he initiated. Barr's successor was the late Prof. J. D. Cormack, during whose tenure of the chair the centenary of the death of James Watt provided an occasion for the establishment of two new chairs, in heat engines and electrical engineering. They were actually founded in 1921, and with the existing John Elder chair of naval architecture, completed (at least, for the time being) the subdivision on modern lines of the comprehensive curriculum that Rankine had undertaken single-handed, and which his own work had done so much to expand. It would be interesting to speculate how the popular attitude towards engineering in general would have been affected if its study had continued under the earlier title of 'natural philosophy'.

Electric Utilities at the New York World's Fair

In the August issue of the *Edison Electric Institution Bulletin*, Mr. Gardner Boyd sums up the results of the first hundred days of the electric utilities exhibits at the New York World's Fair. When the Fair opened its gates on April 30, the electric utility industry presented two separate exhibits to the public. One was designed to give visitors an understanding of the public service objectives and their contributions to present-day living. The other was planned to show farmers the many ways in which electricity will serve them with profit. It has been said that so far the attendance at the Fair has been poor. This is true in comparison with standards required for profitable operation determined by the Fair management in advance of the opening; but so far as the electric utilities exhibit is concerned, attendance has been excellent both from the numerical point of view and from the qualitative aspect. To August 15, the total number of visitors to the main exhibit—Forward March of America—was 3⅓ millions. It has not been possible to make a continuous count of visitors to the electrified farm. From spot checks made frequently and compared with attendance at Forward March of America for the same periods, it appears from these comparisons that the farm draws regularly 75–80 per cent as large an attendance as Forward March of America, and that the total attendance at the two exhibits up to August 15 was approximately six millions.

At the farm there is an information bureau to which many visitors turn. Primarily they want to find out more about the various appliances and pieces of electrical equipment demonstrated at the farm. In order that they may be fully served, they are asked to fill in cards giving their names and home address, the appliances about which they want information and the name of the electric utility that serves them. Many thousands of these cards have been filled up. The information on the cards is promptly forwarded to the manufacturers and others who contributed material and equipment used on the farm, and to the utility companies serving the inquiries named.

Applications of Synthetic Rubber

In an article entitled "Synthetic Rubber" appearing in the *Engineer* of September 13, Mr. A. E. Williams reviews the progress made with the synthetic rubber called neoprene, which was first developed in the United States about seven years ago by the Du Pont Company and is now manufactured by Imperial Chemical Industries Ltd. The starting point for neoprene is calcium carbide; its properties can be varied by incorporating different substances in various proportions. Generally speaking, the initial cost of synthetic rubber is higher than that of natural rubber, but owing to its resistance to temperatures above 140° F. and to acids and oils, it proves much cheaper in the long run. Exhaustive tests have been made to show its resistance to oil, and in one of these, whereas the tensile strength of natural rubber fell to 25 per cent of its original value, the strength of neoprene was reduced only to 93 per cent. It has many uses, among which Mr. Williams mentions those for driving belts, the bonding of metals, inking rollers for printing machines, hoses for petrol and oil, the protection of insulated electric cables, seals for refrigerating apparatus and the manufacture of flexible ebonite, a substance finding many different applications in industry.

Hemp Drug Addiction in India

The October issue of the *British Journal of Inebriety* contains an instructive article by Brevet-Colonel R. N. Chopra and Captain G. S. Chopra of the School of Tropical Medicine, Calcutta, on the present position of hemp drug addiction in India. Hemp drugs in India are at present used in three forms, namely, *bhang*, which is taken as a beverage, while *ganja*,

which is nearly four or five times more potent, and *charas*, the effects of which are even stronger than those produced by *ganja*, are mostly smoked. The cultivation of the hemp plant which grows wild in Northern India along the southern slopes of the Himalayas is strictly controlled for narcotic purposes. The total consumption of hemp drugs in British India during 1934–35 amounted to 1,031,496 lb.

According to the writers there are at least between 855,844 and 1,000,000 hemp drug addicts in India, or approximately 0·5–1 per cent of the total population. The main causes of addiction in order of frequency are association with other addicts, religious and emotional factors, substitution for other drugs, disease and minor ailments, and hard work, worry or strain. The commonest age to contract the habit is between twenty-one and thirty. The effects of the drug on the central nervous system can be divided into three stages: first, the stage of primary stimulation and excitement; secondly, the stage of depression and anæsthesia; and thirdly, the stage of secondary stimulation and excitement. Moderate habitual use may not be attended with harmful effects, but continued excessive indulgence impairs the normal functioning of the nervous system, renders the addict incapable of mental exertion and causes general debility and premature decay.

Robert Boyle

Although Robert Boyle (1627–1691) is well known for his law of compression of gases and for his clear definition of a chemical element (given in his "Sceptical Chymist", 1661), his many other services to chemistry and physics are less appreciated. M. Schofield (*Chem. and Ind.*, 59, 615; 1940) has sketched some of these. Boyle's work in physics centred around his air pump, several models of which were constructed, and his experiments in a vacuum are of considerable interest, particularly in connexion with the barometer, the fact that sound is not propagated in a vacuum, and the boiling of water under reduced pressure. Experiments on freezing mixtures and hydrostatics, including the measurement of specific gravities, were also carried out by Boyle. In the field of chemistry he criticized the prevailing views on elements and pointed the way to a correct view of these, made experiments on combustion which emphasized the importance of the air, investigated the action of acids and alkalis on indicators, prepared phosphorus and ether, and was near the correct interpretation of respiration.

Dr. Désiré Bourneville

Dr. Désiré Magloire Bourneville, a pioneer in the welfare of defective children, was born at Garencières in Normandy on October 21, 1840. He studied medicine in Paris, where he qualified in 1870. Three years later he founded *Le Progrès Médical*, which soon became one of the leading French medical journals. In 1879 he was appointed senior physician to the Bicêtre infirmary, where he took charge of a service almost entirely devoted to idiocy and other forms of mental defect in children and published the *Comptes rendus de Bicêtre*. In the following year he founded the *Archives de Neurologie* under the patronage of Charcot, whose works he had edited some years previously. Bourneville was one of the first in France to confirm Hertoghe's observations on thyroid cachexia and to prove the value of thyroid medication. He was also the first to describe the association of sclerotic nodules in the brain with mental defect and epilepsy which is known as tuberous sclerosis. He took an active part in the laicization of hospitals and in the foundation of training schools for nurses at La Salpêtrière, Lariboisière and Pitié hospitals. In 1905 he retired from the Bicêtre infirmary and was appointed director of the Vallée Foundation for the treatment of idiots and mentally defective children. He died on May 28, 1909.

Luigi Bodio

Luigi Bodio, a celebrated Italian statistician, was born at Milan on October 12, 1840. After serving as lecturer in economics in the Technical Schools of Leghorn, Milan and Venice, he was appointed first permanent secretary of the Central Office of Statistics and in 1878 its director. In 1885 he was elected secretary to the International Institute of Statistics and in 1905 director. In 1901 he was made a senator of Italy. His writings were numerous and varied, the most important being on external commerce (1862), statistics in relation to politics, economics and allied sciences (1869), movement of population in Italy and other European States (1878) and Italian emigration (1894). He died on November 2, 1920.

Amerindian Relics

Some notable additions to the collections of the Smithsonian Institution illustrating the culture and history of the North American Indian peoples are recorded in communications recently issued by the Institution from Washington. The ethnographical interest of these objects is considerably enhanced by their historical and personal associations. Two corn husk dolls, for example, presented by the widow of the late J. N. B. Howitt, who was the foremost authority of recent times on Iroquois culture and philosophy, are notable as being an exact reproduction of the dress of a man and woman of the Iroquois as described in contemporary accounts at the close of the eighteenth century. The Iroquois Federation of the Five Nations, founded in the seventeenth century, played a part of no little importance in the War of American Independence, though disrupted by a divided allegiance. The dresses of both male and female are of blue broadcloth decorated with glass, shell and porcelain beads and coloured ribbons. That of the woman is particularly elaborate.

Among Indian leaders in the war of resistance to the authority of the United States of the later nineteenth century, Sitting Bull, chief of the Sioux, won something of a world-wide reputation. Even in America, where at one time he was regarded as the worst of "bad Indians", he is now often made a

symbol of the struggle of the Indian against conquest and absorption by the white race. Sitting Bull was a shaman or religious leader rather than a war chief in accordance with the dichotomy of function usual among these proples. Authentic relics of this chief are rare, although pairs of moccasins said to have belonged to him are found in collections scattered widely over America and Europe. The authorities of the Smithsonian Institution hitherto have allowed authenticity to one relic only in their collections, a sawed-off flint-lock taken at the time of his surrender. To this is now added a red clay tobacco pipe and buckskin tobacco pouch presented by the widow of Major-General James McArthur, who obtained them from the chief when he himself was a lieutenant in the Seventh U.S. Infantry. The pipe is of catlinite, the red clay of the Upper Missouri, commonly used by the Indians for this purpose, and has a long rectangular wooden stem. The pouch is 17 inches long with characteristic Sioux decorative work in glass beads and dyed porcupine quill.

New Fossil Primate from Sterkfontein, South Africa

Further study of the large human-like third upper molar of which the discovery at Sterkfontein was recorded recently by J. C. Middleton Shaw in the columns of Nature (**143**, 117; 1939) and a comparison with remains of the fossil Plesianthropus and Paranthropus of Broom have led to some interesting conclusions as to the possible significance of this new Sterkfontein primate. These further considerations have been discussed by Dr. Shaw in a communication to the *Annals of the Transvaal Museum* (20, 2; 1940). There would appear to be no doubt that the new molar belongs to neither Plesianthropus nor Paranthropus; and it differs from the third molars in all the material from fossil apes which has been described by W. K. Gregory. If, therefore, it belonged to a fossil ape, it must be concluded that that ape differed, at least so far as the upper third molar is concerned, from any ape hitherto described.

Evidence of the character of the corresponding tooth in fossil man, unfortunately, is inadequate. Dr. Shaw, however, detects certain resemblances between his tooth and that in Sinanthropus, except that it is larger and presents certain differences as to the crown, while there is, again with the same proviso as to size, a resemblance in the moderate taurodontism and smooth simple crown surfaces to certain Neanderthal specimens. Although no fossil human remains have been discovered at Sterkfontein, Dr. Shaw puts forward the tentative suggestion that the tooth of his discovery may be a relic of an early African human type, possibly of Pleistocene age and, therefore, a contemporary of Plesianthropus and Paranthropus. If this should be confirmed by further evidence, this is the first fossilized remains of man discovered in the Union of South Africa.

Excavation at Gnezdovo, U.S.S.R.

Soviet archæologists have recently made interesting discoveries during excavations at the village of Gnezdovo, near Smolensk. The vicinity is a veritable treasure-house of Slavonic monuments; in it are up to 7,000 tumuli, numerous settlements and small towns relating to the first 1,000 years before our era. Excavations have been completed of the central town at Gnezdovo, considered by many archæologists as the original town of Smolensk. An area of 120 square yards was uncovered up to an average depth of 6½ ft. In one half of the excavated area was revealed an ancient Slavonic earthen dwelling place with a stone fireplace and hearth and many utensils. There were found bone, flint and iron implements, and primitive clay pots. Copper articles (clasps and buckles) found there indicate that the dwelling place relates to the middle of the first 1,000 years of our era.

In the other half of the site excavated was discovered a very rare burial; lying on a funeral pyre was a half-burned woman in full attire and wearing many ornaments. Around her throat was a valuable necklace; suspended from a silver chain was a golden Byzantine coin, six highly ornamented gold medallions and five silver medallions. Below the medallions hung a number of multi-coloured beads, including silver ones. It is believed that the burial relates to the tenth century, and that the ornamentation is of Byzantine origin.

Gold Mining in Wales

Mining for gold has been carried on in various parts of Wales during the past two thousand years, but has experienced many vicissitudes and has frequently lapsed for long periods at individual workings. An attempt was made some three years ago to bring again into commercial production the Roman Deep mine at Pumpsaint, Carmarthenshire, but circumstances were adverse to the venture. According to *Engineering* of September 20, the plant has now passed into the hands of Messrs. George Cohen, Sons and Company, Ltd., for disposal. Local tradition says that the name 'Pumpsaint', which means five saints, is linked with a stone, having in one surface five small depressions, supposed to have been caused by the heads of five saints who used it as a pillow. Messrs. Cohen suggest that the hollows were caused by primitive ore-crushing stamps, and that the stone was part of the very early plant used at the mine.

The Start of Education

"Elementary Education: What is It?" (U.S. Office of Education, Bulletin 1940, No. 4, Part 1) is the first of four summaries which have followed a conference in 1938 on the subject. It is planned to give a bird's-eye view with relation to later studies and is valuable as presenting the views and criticisms of many teachers, though a little heavy in its methods of exposition. The general public needs to realize in simple language that the word 'education' means not pushing in information but drawing out the best that a child can do. To note among the experiences to be included in an elementary school "analysing" and "evaluating" seems rather advanced for a tender age, unless the child's determining of values provides

hints for the teacher; one of Mark Twain's clever children valued her mother most and the new kitten came next. Elementary schools hold the centre of the stage so far as numbers are concerned. There were in the United States nearly 23 millions of the teachable in 1936, and between that date and 1930 a decrease of 4 per cent in attendance is noted. But States vary widely in the opportunities they supply.

What is said of a broad interpretation of the curriculum and of mental growth is excellent. Dramatic play, begun naturally by children as individuals, should be organized as a regular part of the school programme. It is well to take long views about later life, where education goes on steadily among the wise. The main business is to discover a child's special aptitudes and get over a reluctance to tackle subjects which may appear difficult, such as arithmetic. But, while there is talk of a "stable and desirable type of personality" as one of the aims to be achieved, and of democracy and good citizenship, we find nowhere any declaration whether the child is to be educated to meet the current standards in business, or to reach a higher morality which is dissatisfied with them. Culture has in practice little chance of competing with the attractions of that broad way, the *via dollarosa*.

Recent Earthquakes

FOUR strong distant earthquakes were registered at Kew Observatory during September. They were on September 12, 19, 21, and 22. The second of these was the greatest, having a ground amplitude at Kew of 47 μ, and being estimated at a distance of 17,400 km. The second was at a distance of 6,100 km. with an estimated depth of focus of about 390 km., whilst the third, probably distant about 140°, had a depth of focus of approximately 500 km. News from other observatories is awaited before the epicentres and depths of focus can be given with precision.

On September 4, two local earthquakes were felt in Palestine each of which lasted about 10 seconds. No damage has been reported and the shocks were not registered at Kew. It is reported in the Press that an earthquake was felt in Copenhagen early on September 28. No damage was reported. Earthquakes are rare in this district and the shock may have been caused by fault slipping in the Sound separating Denmark from Sweden.

The coast of Chile in the neighbourhood of Iquique was shaken by a violent earthquake about 6 a.m. (local time) on October 4. Reports of damage and details of the shock are not yet to hand. Chile as a whole is very liable to earthquake shocks, and Iquique has been affected on a number of occasions in the past, notably on May 9, 1877, when there was widespread destruction due to large sea waves caused by the earthquake in addition to the extensive damage done by the earthquake itself, and on January 23, 1878.

During April, May, June 1940 forty-seven earthquakes were registered at the Riverview College Observatory, New South Wales, as compared with fifty-six in the first quarter of the year. The Observatory is equipped with two Wiechert horizontal 1,000 kgm. instruments, one Wiechert vertical seismometer of 80 kgm., two Mainka 450 kgm. seismometers and three Galitzin aperiodic seismometers with galvanometer registration, orientated north-south, east-west and vertical. The largest two shocks of the period appear to have been on April 1 when an amplitude of 23 mm. was obtained and on May 28 when an amplitude of 22 mm. was reached. The shock of April 18 was felt in the region of the Duke of York Islands, New Britain, etc. The shock of May 24 is reported to have had its epicentre in Peru, and the earthquakes of June 18 and June 22 were deep focus shocks. The instruments are occasionally affected by microseisms which are at times severe. The microseisms do not often preclude the accurate reading of the seismograms, details of which are given in the Observatory report.

Research on Juvenile Leisure

THE Socio-Psychological Department of the Manchester and Salford Council of Social Service is engaged in research into the problems of leisure time activities of juveniles. The research at present is centred around the psychological difficulties of juveniles in taking up educational leisure-time occupations. The department wishes to get in touch with those who have conducted similar research in order to co-operate and co-ordinate the research done. Information can be obtained from G. Wagner, Manchester and Salford Council of Social Service, 16–18 Queen Street, Manchester 2.

Announcements

PROF. A. EINSTEIN, who has been professor of theoretical physics in the Institute for Advanced Studies at Princeton since 1933 has been admitted to American citizenship.

DR. MILAN A. LOGAN, assistant professor of biochemistry at Harvard University, has been appointed Andrew Carnegie professor of biochemistry in the College of Medicine of the University of Cincinnati, in succession to Dr. Albert C. Mathers.

DR. W. A. CLEMENS, director of the Pacific Biological Station at Departure Bay, a branch of the Fisheries Research Board of Canada, has been appointed head of the Zoology Department of the University of British Columbia.

THE Academy of Sciences of the U.S.S.R. has awarded the Pavlov Prize for 1940 to Prof. Maria K. Petrova, of the Pavlov Institute of Physiology and the Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity. The annual Pavlov Prize of 20,000 roubles, for the best work in the field of physiology, was instituted by the Soviet Government in 1936. The winner of the Prize this year is known for her study of experimental neuroses, their mechanism and therapy. She has written a treatise on this subject, one volume of which has been published, and the other is in the press.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

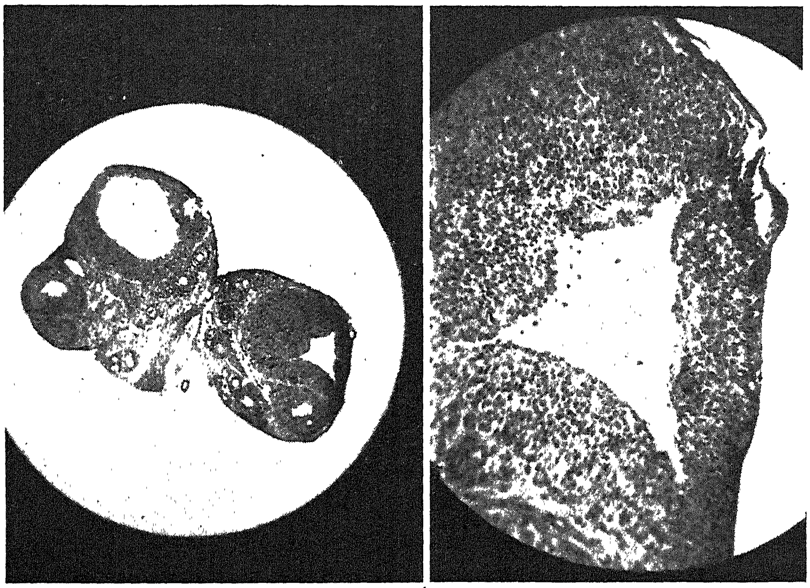
In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Gonadotropic Hormones in the Urine of the Giraffe

It has been considered that during pregnancy only the primates excrete gonadotropic hormones in high concentration in the urine, and that pregnant Equidæ do not, although the concentration of gonadotropic substances may be increased in the blood. It was not expected that antelopes would give positive results.

We had occasion to examine the urines from a number of captive giraffes and the following preliminary results are of importance.

The first animal, a female 2-para, aged six years, was mated on December 24, 1937, and her female calf was born on April 8, 1939 (468 days).



A B

Examination of the urine for gonadotropic hormone gave a negative result on August 24, 1938, but later specimens examined on November 11 and 26, 1938, showed positive ones when tested on rats and mice by the method of Ascheim and Zondek. Thus a group of 12 rats receiving 3·6 c.c. of the latter two urines, which were shaken out with ether before injection, gave the following results:

	No. of rat	Body-weight	Œstrus	Weight of the ovaries	Histology of the ovaries
Nov. 11,	18871	26·6 gm.	*G*	11 mgm.	III
1938.	18872	28·0 ,,	*G*	9 ,,	I
	18873	28·0 ,,	*G*	11 ,,	III
	18874	30·4 ,,	*G*	13 ,,	III
	18875	25·8 ,,	*D*	9 ,,	—
	18876	26·8 ,,	*F*	14 ,,	III
Nov. 26,	19099	29·0 ,,	*G*	16 ,,	III
1938.	19100	27·8 ,,	*A*	10 ,,	I
	19101	26·6 ,,	*A*	9 ,,	I
	19102	27·0 ,,	*G*	11 ,,	III
	19103	26·0 ,,	*A*	6 ,,	—
	19104	30·4 ,,	*B*	8 ,,	I

A = typical anœstrus vaginal smear; *B* = decreased number of leucocytes, increased number of not cornified epithelial cells; *G* = a vaginal smear with less than 5 per cent of leucocytes and more than 95 per cent cornified epithelial cells; I = enlarged follicles present; III = corpora lutea present.

The typical effects in the ovary of rat 19102 are seen in the two accompanying illustrations; *A* shows a section from the whole organ and *B* a young corpus luteum at higher magnification. The changes produced are comparable with those found in rats after the administration of gonadotropic hormones of the chorionic type (few but large corpora lutea).

Examinations of the urines from other non-pregnant female giraffes and also a male giraffe gave negative results.

Our preliminary results thus indicate that the excretion of gonadotropic hormones during pregnancy is not limited to the primates as is generally assumed, but also occurs in the antelopes. We are continuing this work and are now repeating our observations on the original female giraffe.

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P. de Fremery.
Dept. of Clinical Investigations and Research,
Manchester Royal Infirmary and University,
and
Organon Laboratories, Oss.
August 31.

Volatile Aldehydes Liberated by Periodic Acid from Protein Hydrolysates

Nicolet and Shinn[1] and Van Slyke *et al.*[2] have studied the action of periodic acid on hydroxyamino-acids, and in the cases of serine and hydroxylysine have demonstrated the rapid formation of one mole-

cule of formaldehyde. Block and Bolling[3] have made use of the rapid formation of one molecule of acetaldehyde from threonine on oxidation with lead tetracetate for determining this amino-acid in protein hydrolysates.

We find that periodic acid in an aqueous solution of sodium bicarbonate rapidly liberates acetaldehyde from threonine; the acetaldehyde was identified as the 2:4-dinitrophenylhydrazone. In quantitative work the volatile aldehyde liberated was determined by the method of Friedemann and Kendall[4] after aeration from the reaction mixture into an absorption tower containing bisulphite solution. Under the same conditions serine gave no volatile aldehyde. This is in agreement with the published data[5] on the vapour pressure of formaldehyde in aqueous solution at room temperature. Thus aeration affords a simple analytical procedure for the separation of formaldehyde from other lower aliphatic aldehydes in aqueous solution.

Under the same conditions, alanine, cystine, methionine, hydroxyproline, β-hydroxyglutamic acid, tyrosine, tryptophan, arginine and histidine yield no volatile aldehyde.

We have determined the volatile aldehyde liberated in this manner from various protein hydrolysates. The proteins were hydrolyzed with HCl, and excess of this was removed by repeated evaporation *in vacuo* before treatment with excess of HIO_4-$NaHCO_3$ at room temperature. The following values were observed:

Protein	Volatile aldehyde as N in % of total N of protein (1 mol. aldehyde = 1 atom N)
Wool (Merino 64s)	3·3
Casein	2·1
Gelatin (Coignet Gold Label)	1·0
Wheat gluten	1·2

Volatile aldehyde was in each case recovered in good yield from threonine added to the protein hydrolysate before the determination.

The volatile aldehydes were examined qualitatively by conversion to the 2:4-dinitrophenylhydrazones, which were identified by comparison with authentic aldehyde dinitrophenylhydrazones and mixtures of these derivatives. Melting points, mixed melting points and X-ray powder photographs were employed, the X-ray work being kindly carried out by Dr. W. T. Astbury, Dr. Florence O. Bell and Dr. K. M. Rudall, of the University of Leeds.

In the cases of wool, casein and gelatin only the acetaldehyde derivative was obtained, but with gluten a mixture of the dinitrophenylhydrazones of acetaldehyde and propionaldehyde resulted. The X-ray photographs seem to be conclusive that the mixture contains the propionaldehyde derivative besides that of acetaldehyde, but there are strong indications that the two form mixed crystals in certain proportions, and the presence of derivatives of still higher aldehydes is not definitely excluded. Both these latter aspects of the matter are being investigated further.

The liberation of propionaldehyde suggests, by analogy with the behaviour of threonine, that β-hydroxynorvaline may be present in the hydrolysate of gluten. It is interesting in this connexion to note the reported isolations from oatmeal protein[6,7] and zein[8] of preparations having the elementary composition of hydroxyvaline. No structural evidence was published in respect of these. Abderhalden and Heyns[9] prepared from synthetic β-hydroxyvaline and β-hydroxynorvaline the derivatives made by Schryver and Buston[6] and by Brazier[8] and found no agreement in properties; the preparations from protein were optically inactive, and Abderhalden and Heyns employed the racemic compounds for comparison. They did not, however, in the case of β-hydroxynorvaline take into account the existence of two centres of asymmetry in the molecule, which leads to four active and two racemic isomers. A specimen of the product of Czarnetzky and Schmidt[7] was considered by them to be leucine.

It is intended to undertake an isolative investigation of the substance giving rise to propionaldehyde.

A. J. P. MARTIN.
R. L. M. SYNGE.
(International Wool Secretariat Student)

Wool Industries Research Association,
Torridon, Headingley,
Leeds, 6.
September 6.

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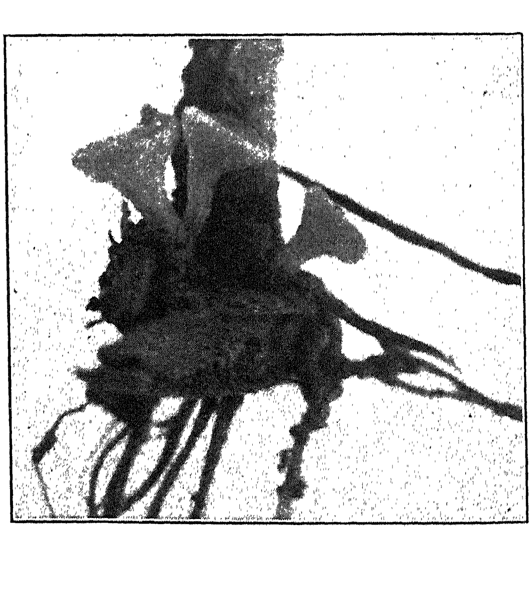
[2] Van Slyke, Hiller, MacFadyen, Hastings and Klemperer, *J. Biol. Chem.*, **133**, 287 (1940).
[3] Block and Bolling, *J. Biol. Chem.*, **130**, 365 (1939).
[4] Friedemann and Kendall, *J. Biol. Chem.*, **82**, 23 (1929).
[5] Blair and Ledbury, *J. Chem. Soc.*, 26 (1925); Ledbury and Blair *ibid.*, 2832 (1925).
[6] Schryver and Buston, *Proc. Roy. Soc.*, B, **99**, 476 (1925).
[7] Czarnetzky and Schmidt, *J. Biol. Chem.*, **92**, 453 (1931).
[8] Brazier, *Biochem. J.*, **24**, 1188 (1930).
[9] Abderhalden and Heyns, *Ber. deutsch chem. Ges.*, **67**, 530 (1934).

Blind Seed Disease of Rye-Grass

WITH reference to the communication from Muskett and Calvert[1], we wish to record that in 1891 Prillieux and Delacroix[2,3] described, in France, a parasite *Endoconidium temulentum*, on rye (*Secale cereale*), which possessed toxic properties. The genus Endoconidium was based on this fungus on account of the endogenous formation of its microconidia. Its perfect stage was later variously ascribed to the genera Phialea, Stromatinia and Sclerotinia. In the blind seed fungus we have found that the microconidia are produced endogenously as in Endoconidium; measurements of the apothecia, ascospores and microconidia agree closely in the two fungi; also



positive results have recently been obtained by infecting the flowers of rye with spores of the blind seed fungus. The only point of difference is that macroconidia have not been described in Endoconidium.

Then while Muskett and Calvert[1] report apothecia of the blind seed fungus only on dead rye-grass seed, we have found as many as three of these apothecia on a caryopsis which has given rise to a perfectly normal seedling, as shown in the accompanying figure. This suggests that the fungus does not always behave as a pathogen. Several systemic fungi have already been reported on *Lolium perenne*; McLennan[4,5] has described one endophyte and one mycorrhizal fungus, Sampson[6] a second endophyte which produces microconidia, and Neill[7] has described an endophyte which may be identical with that described by McLennan; this last was found in the course of an investigation into a suspected herbage toxin. The results of our cultural experiments suggest that these systemic fungi may not be entirely dissociated from one another or from the blind seed fungus.

With regard to the Pullularia occurring along with the blind seed fungus, our experiments have had similar results to those reported by Muskett and Calvert; it appears that Gemmell[8] described the blind seed fungus under the name *Pullularia pullulans*.

A consideration of the foregoing statements indicates that neither the cause of the low germination of rye-grass nor the identity of the associated fungi has yet been adequately investigated. A fuller account of work on these points will be published in due course.

In view of the recent letter from Glasscock[9] on this subject we should like to emphasize that infection with the "blind seed fungus" is not necessarily correlated with low germination in rye-grass. In a recent test, of 19 seeds bearing conidia of the fungus 13 germinated and have given rise to normal plants.

Malcolm Wilson.
M. Noble.
E. G. Gray.

Department of Mycology,
University of Edinburgh,
and
Plant Pathology Service,
Department of Agriculture for Scotland.

[1] Muskett, A. E., and Calvert, E. L., Nature, **146**, 200 (1940).
[2] Prillieux, E., and Delacroix, G., *Bull. Soc. Myc. Fr.*, **7**, 116 (1891).
[3] Prillieux, E., and Delacroix, G., *Bull. Soc. Myc. Fr.*, **8**, 22 (1892).
[4] McLennan, E., *Proc. Roy. Soc. Vict.*, **32**, N.S. 252 (1920).
[5] McLennan, E., *Ann. Bot.*, **40**, 43 (1926).
[6] Sampson, K., *Trans. Brit. Myc. Soc.*, **21**, 84 (1937).
[7] Neill, J. C., *N. Zealand J. Sci. Tech.*, **21**, 280A (1940).
[8] Gemmell, A. R., *W. Scot. Agric. Coll. Bull.*, 136 (1940).
[9] Glasscock, H. H., Nature, **146**, 368 (1940).

Non-parallelism of Lattice Planes in Tin Coatings on Steel

X-ray and optical examination of the crystals of the tin layer of tinplate has shown that a continuous change of orientation takes place along such crystals in their direction of growth.

Back-reflection X-ray photographs taken at a series of points along such a crystal are characterized by a movement of the reflection spots from one photograph to the next. Photographs taken with the specimen moved uniformly during the exposure consist of continuous lines instead of spots. It follows that a change of orientation takes place along the crystal, and that this change is continuous.

Visual inspection of an etched surface of such a crystal, or inspection by the optical method previously used for the determination of the orientation of tin crystals[1] confirms the existence of the effect. It is observed in exceptional cases that the crystals undergo several complete rotations, as evidenced by the periodic appearance of bright patches on the etched surface. The extent of the rotation is variable, but in the few cases where it has been measured it has had values up to 40° per cm.

The proposed explanation is that the conditions of formation of the layer cause a greater concentration of iron in the tin near the tin-iron interface than at the free surface, and that this causes a gradual contraction of the lattice as the interface is approached. Calculation shows that a contraction of the lattice of 0·04 per cent at the tin-iron interface would introduce a departure from parallelism in the lattice planes sufficient to account for the observed rotation.

It is also suggested that this explanation may apply to the striated structure sometimes observed in the tin layer on copper tinned by hot-dipping[2].

It is to be expected that this type of 'non-parallel crystal lattice' would be present wherever a concentration gradient exists as, for example, in cored crystals, under such conditions that the lattice spacing depends on the concentration.

It is hoped that a full investigation of this effect will be undertaken in due course, but the present abnormal conditions may cause considerable delay in full publication.

Bruce Chalmers.

International Tin Research and
Development Council,
Fraser Road,
Greenford,
Middlesex.
September 16.

[1] *Proc. Phys. Soc.*, **47**, 733 (1935).
[2] *Trans. Farad. Soc.*, **31**, 1299 (1935).

Submarine Canyons

Prof. W. H. Bucher, as reported in Nature[1], argues that the marvellous submarine canyons of the continental slope are due to tsunamic (or tunamic) waves. I am delighted to find this view advanced by so competent an authority, for though I gave evidence for its adoption in 1938[2], my voice has been as of one crying in the wilderness. In fact, Prof. Douglas Johnson, in an approximately complete recent survey of the subject[3], has overlooked the seismic possibility altogether, except for very limited applications put forward by Prof. F. P. Shepard[4] from 1931 onwards.

E. B. Bailey.

Geological Survey and Museum,
London, S.W.7.

[1] Bucher, W. H., Nature, **146**, 407 (1940).
[2] Bailey, E. B., *Trans. Geol. Soc. Glasgow*, **20**, 1 (1938).
[3] Johnson, Douglas, "The Origin of Submarine Canyons" (New York, 1939).
[4] Shepard, F. P., *U.S. Coast and Geod. Surv. Assoc. Field Eng.*, Bull. **3**, 87 (1931).

RESEARCH ITEMS

Archæology of Fanning Island

FURTHER information relating to the ruins of Fanning Island, one of the equatorial islands of the Pacific, was obtained by Kenneth P. Emory in 1934 when he visited the island again after an interval of ten years (Bernice P. Bishop Museum, *Occasional Papers*, **15**, 17; 1939). Three additional ruins were noted and examined and four basalt adzes found after the departure of the first expedition were studied. The three ruins now described lie on a ridge of sand along the south side of a trail from the lagoon jetty and the cable station. Of the first only a small pile of coral 10 ft. in diameter and a foot high remains. Several small slabs on edge are planted here and there, and an area less than 16 ft. is covered with scattered stones. The next structure, nearly 60 yards to the west, is a small collection of loose slabs which may originally have formed an alignment. The third ruin, 47 yards farther west, is the most definite. It seems to have been a mound or platform covering two vaults constructed at ground-level. At the south end kerbs mark a rectangle 6 ft. by 10 ft. Around the outside edges are many loose slabs in disorder and smaller stones which must have served as the fill of a grave or have formed a platform built over the vault. Human teeth, fishbones and one-piece fishhooks found within the rectangle point to its use as a grave. Firmly embedded kerbs and two large limestone slabs north of the rectangle suggest another grave. There is a suggestion of a retaining wall at the north border of the ruin. About 400 ft. south-west is a place where limestone slabs had been quarried in ancient times. The four adzes resemble those of Samoa and Tonga, and not those of the Marquesas, Hawaii, Cook Islands, Society Islands and other groups of marginal Polynesia. The fishhooks, composite and one piece, relate to Tonga. The dressed stone enclosure has affinities with the royal burial places of Tonga and its sixteenth century dressed stone work, but nothing like it is found outside Tonga. The marking of burials with conspicuous superstructures of stone is a strong feature of western Polynesia, weak or absent in eastern and marginal Polynesia.

Folding of the External Ear of Lorisoid Monkeys

THE ear pinna of Galagos and their relatives is capable of a peculiar folding designed to protect a sensitive organ and brought into action when the animals desire to avoid objects which might cause physical injury. If some object is suddenly thrust towards the ear it immediately retracts, and retraction is the typical condition in sleeping animals. W. C. Osman Hill finds that the ears of the Lorisoid genera Loris, Nycticebus and Galago are characterized by having transverse discontinuities in their cartilages near the upper extremities (*Ceylon J. Sci.*, Sect. 13, **22**, 135; 1940). These discontinuities are bridged over by perichondrium and are connected with the presence of a lamina of striped muscle fibres (corrugator pinnæ) under the control of the will. Some of the differences between Loris and Nycticebus on one hand and the Galagos on the other are associated with the more active habits of the latter, which demand a more sensitive, in other words a more expanded organ, and hence one that is more actively contractile. Tarsius differs from these genera in lacking all these specialized structures, but is more typical in possessing a tragus.

Californian Trout

COMPARED with the meagre range of trout species in Britain, Californian rivers and lakes contain remarkable variety. John O. Snyder lists nine species of Salmo belonging to the rainbow trout series, four species in the "cut-throat" series, and one species of char, *Salvelinus spectabilis*. Not satisfied with these, enthusiasts have introduced Loch Leven trout from Scotland, and four other species from various parts of the United States (*Calif. Fish and Game*, **26**, 96; 1940). Short descriptions of all these species, some illustrated by photographs and coloured plates, indicate salient characters, and brief accounts of migration and the barriers to migration, scale-reading, conservation, food-habits, artificial propagation and distribution have been contributed mainly for the information of anglers and the inquiring layman.

Ripening of the Banana

THE banana differs from many other fruits in that cut from the tree (after allowing some forty days for early stages of development) it will continue to ripen—none the less the developmental processes at work whilst on the tree probably have a determining influence in respect of the time limits at which fruit may be cut for exportation. Considerable practical importance probably is attached, therefore, to such studies as those described by H. R. Barnell, of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad (*Ann. Bot.*, N.S., **4**, 1940). He has followed the changes in dry matter and various types of carbohydrates and acidity in the pulp and skin of the fruit, during development in the plant, from the time the fruits emerged until they rotted. It had been proposed to study the quality of fruit left to ripen on the plant, but in these Trinidad observations, after the 'hundredth' day, the fruit began to split and then to fall and rot. It would seem that the Gros Michel variety under these conditions is more suited to picking at an incipient ripening stage and export than for home consumption as ripe fruit gathered from the plant. The banana is relatively unusual also in the low sugar content in the early stages of development, when starch is rapidly accumulating; the splitting later is associated with a rise in water content of the pulp as the sugar content begins to increase. Off the plant bananas at this period will ripen with sugar formation in the pulp, but there is less danger of splitting as only a relatively small amount of water can migrate into the pulp from the skin. Unlike the apple in its high starch accumulation and low sugar concentration, the banana also differs in that along with starch synthesis there is a continuous fall in the acidity of the pulp—rising acidity values are only met with as starch hydrolysis begins after about the 'hundredth' day.

Life-Cycle of *Blastocladia Pringsheimii*

The discovery, by Kniep in 1929, that the water mould *Allomyces javanicus* exhibited heterogamy of flagellate gametes, focused attention upon closely related fungi for the possibility of similar phenomena. Elizabeth Blackwall has studied the life-history of an allied species, *Blastocladia Pringsheimii* (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 68–86; June 1940). Resting spores were successfully germinated, but no gametes were demonstrated. Motile swarmers appeared, however, and formed germlings which grew directly into the characteristic pustule. There is, therefore, as yet no evidence of a sexual phase in this life-cycle, but the demonstration of apparently non-sexual swarm spores in a Phycomycete is nevertheless of considerable mycological interest.

Genetics of Verbena

G. H. Beale (*J. Genetics*, **40**, 339–358; 1940) shows that the garden Verbena derives its variation from two sources. The first source is derived from hybridization between four species of Verbena. Eight gene differences are presumably derived from this hybridization; these show various degrees of dominance. On the other hand, ten gene differences resulting from mutation during the last hundred years show complete dominance of the 'wild type'. There are two series of triple allelomorphs in which the extreme dominant and recessive members produce a similar phenotypic effect, which differs from the intermediate member of each series. Aberrant ratios, modifying factors and exceptionally close linkages are probably related to the hybrid origin of the garden Verbena.

Theory of Differential Periodicity

G. F. Sleggs (*J. Genetics*, **40**, 385–392; 1940) has amplified his theory of differentiation of an organism. He suggests that differentiation is due to the direct action of genes which are arranged on the chromosome at various angles of rotational stagger. The formation of new nuclei is equivalent to the spreading of chemical lattices in superimposition, thus producing an optical pattern. Such staggering of genes in the chromosome column produces strain which gives rise to the high synthetic activity of living matter. Sexual interaction involves chemical union between gene columns of different stagger form, thus intensifying synthesis (growth) in the diploid. Crossing-over, dominance, lethal genes, the origin of species, and species divergence are discussed in relation to this theory.

Use of Refrigeration to Delay Age-hardening

The age-hardening which takes place in duralumin after the normalizing treatment brings about a pronounced and rapid decrease in ductility. Whereas the effects of age-hardening on the proof stress, ultimate strength, and hardness require about four days for completion, a decrease in ductility sufficient to interfere seriously with cold-pressing operations takes place in rather less than two hours. It is known that the rate of age-hardening can be retarded by lowering the temperature of storage of the freshly normalized material. Experiments have been carried out by Arrowsmith and Wolfe (*J. Inst. Metals*, **66**; 1940) to demonstrate the relationship between this temperature and the rate of age-hardening, with the object of determining the maximum temperature at which a desired increase in permissible storage time can be obtained. A practically convenient time is four days, and this is made possible by storing at a temperature of $-6°$ to $-10°$ C.

Impregnation of Poles with Copper Sulphate

An abstract of an article by Yosio Nakazima, on the rapid deterioration of poles impregnated with copper sulphate, has been published in the April number of the *Quarterly Journal of the Institute of Electrical Communication Engineers*, Tokyo. The author, who is a member of the Sendai Bureau of Communications, gives an account of an investigation carried out to find why copper sulphate impregnated poles erected in a certain district by the Sendai Bureau deteriorated so rapidly. Experimental investigation showed that it was due to the properties of the ground where the poles were erected, the ground becoming alternately moist and dry and thus dissolving the copper sulphate. A preserving band for preventing this was purchased in the market, but it was no more effective than the procedure previously carried out of scraping away the rotted portion and coating it with creosote. Poles impregnated with creosote by the Bessel process are best suited to this kind of soil. In the present method of investigation, much importance is placed on the amount of copper sulphate per average cubic metre, and little attention is given to the uniformity of the cross-sectional presentation. It was found that this uniformity was most important. It is believed that by diluting the solution used at present for impregnation to a density that would deposit about 3·5 kgm. of copper sulphate, and by impregnating the pole well and uniformly, the same degree of protection can be attained as in present practice. This subject well deserves further study, especially from the economic point of view. The original paper gives a discussion of the method used at the Sendai Bureau of Communications for testing the finished impregnation.

Solar Faculæ and Solar Constant Variations

H. Arctowski read a paper on this subject at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The daily solar constant values for the years 1926–1930 have been compared with the areas of faculæ in order to search for the direct correlation between solar phenomena and the variations of solar radiation advocated by C. G. Abbot. The solar constant data have been taken from vol. 5 of the *Annals* of the Astrophysical Observatory of the Smithsonian Institution and those of the areas of faculæ from the results of measures made at the Royal Observatory, Greenwich, of photographs of the sun taken at Greenwich, at the Cape and in India. It has been found that the mean values for the days of maxima and minima of the solar constant and the five days preceding and following these days give curves similar to those of the faculæ of the same dates. The mean maximum as well as the mean minimum of the solar constant variation, however, are slightly in advance of those of the faculæ.

DRUGS AND WAR-TIME ALTERNATIVES

FOR the guidance of general practitioners, hospitals and drug manufacturing houses, an official committee composed of recognized medical authorities, acting under departmental ægis, has compiled a list of drugs the importation of which is considered unnecessary. It is suggested that drugs on this list should be used with the strictest economy while the War continues. The purpose of this recommendation is to support the Government policy to cease using cargo space and foreign currency to import drugs which are not essential in war-time or for which substitutes can be obtained at home.

The official committee suggests substitutes which are considered suitable for some of the drugs included in the list. Instead of aconite, it is suggested that benzocaine should be used for local application; since the sources of aconite are Germany, Switzerland and France, importation is not possible. The note against Balsam of Tolu (a South American product) is that no substitute is necessary. With regard to buchu leaves, cubebs, balsam cophiba and sandalwood oil, it is suggested that one or other of the following substitutes should be used: sulphanilamide, hexamine, mandelic acid, sodium benzoate, scoparium. In place of the Mozambique drug, calumba root, the use of quassia is indicated. As a substitute for cantharides, the sources of which are Spain, Russia, Hungary and China, mustard is suggested.

Small production of English caraway seed is available; in the past our main supplies have come from Holland or Germany; home production should be encouraged but, in the meantime, aniseed is suggested as a substitute. The importation of cassia from China is unnecessary. Instead of coriander seed, derived mainly from Morocco and Russia, the use of cardamons is proposed, supplies being plentiful. Male fern and carbon tetrachloride are suggested as substitutes for cusso. The therapeutic value of fig is said to be doubtful.

Synthetic analgesics are recommended to replace gelsemium, an American importation. Another American drug, hamamelis, might be replaced by tannic acid. Instead of Mexican jalap and its resin, the use of colocynth, stocks of which are of fair size, is proposed. Tannic acid is suggested in place of krameria, and kaolin in place of linseed for poultices. Lobelia herb, which comes from the eastern United States, may be replaced by nikethamide or leptazol, or by stramonium, should the home-produced drug be available. As substitutes for pelletierine tannate, which is derived from Mediterranean countries, male fern and carbon tetrachloride are recommended. Indian podophyllum is suggested instead of the American root, and isphagula instead of psyllium seed. Salicin may be replaced by sodium salicylate, scammony by Indian podophyllum and senega root by iodides, ammonium bicarbonate and ammonium chloride.

PROGRESS IN SEISMOLOGY

THE forty-fifth report of the British Association committee on seismological investigations was to have been presented at the meeting to have been held at Reading. This meeting was cancelled, but the report in question is now in print.

In spite of the War, seismology has made progress in Great Britain during the year. The committee has Milne-Shaw seismographs on loan at Oxford (2), Cape Town (2), Edinburgh and Perth (West Australia). All these are in operation, except one at Oxford. There is also a Jagger shock recorder in operation at Comrie. The seismograph (Milne-Shaw No. 63) and seconds regulator clock sent to Fiji last year have not yet been erected. They are awaiting the construction of the projected meteorological station at Suva, which will most likely be a matter of only a few months. A complete new recording outfit supplied with two motors and drums, one spring-driven and the other with an electric drive, has been sent to Entebbe. The original recording units sent out in 1923 have also been overhauled and repaired in West Bromwich and returned. New mirrors have been sent to several Indian stations.

Miss E. F. Bellamy is carrying on with the work at Oxford with the part-time assistance of Mr. Cook, in the absence of Mr. J. S. Hughes and Prof. H. H. Plaskett. The old system of co-ordinates has been used in the preparation of the International Seismological Summary, since no decision was taken at Washington last September on the adoption of geocentric co-ordinates. Very little material is now being received for the Summary. Last September the Milne-Shaw N-S seismograph at Oxford was dismantled and stored for safety, the seismological basement being well shored up and protected. During the year, Mr. R. E. Ockenden has again made a valuable gift to the John Milne Library, and the British Association Seismological Committee has been responsible for publishing new seismological tables by Dr. H. Jeffreys and Dr. K. E. Bullen.

The Accra earthquake of June 22, 1939, has been investigated, all the macroseismic work being conducted by the Geological Survey of the Gold Coast under the direction of Dr. N. R. Junner. The focus was found to have been below a very steep slope in the bed of the ocean to the south of Accra, and it is hoped that full details will be published in due course.

Dr. A. T. Dollar is continuing the work on British earthquakes from the Geology Department of the University of Glasgow. Further matter has been obtained for the catalogue of British earthquakes for the period January 1, 1916–October 1, 1935, and 27 more permanent voluntary observers have been added to the 321 previously on the list, though Channel Islands observers have been lost owing to evacuation. Since July 1, 1939, the following British earthquakes have been investigated: July 18, 1939, Manchester; February 2–3, 1940, Stirling; March 18, 1940, Birmingham; and a mine shake, July 5, 1939, Bargoed, Glamorgan. Information is now being collected concerning the earthquakes of July 9, 1940, North Argyllshire, July 14–15, 1940, West Midlands, and July 16, 1940, Stirlingshire.

WHEAT DIET AND LEPROSY

IN a valuable paper published recently, Drs. R. G. Cochrane and M. Paulraj, and Miss M. D. Salmond (*Indian J. Med. Res.*, **27**, 4; 1940) discuss the results of their treatment of certain symptoms in leprosy by the administration of a wheat diet. The experiments were carried out at the Lady Willingdon Leper Settlement during the last two years.

The authors point out that it has been recognized since the publication of Jonathan Hutchinson's book on leprosy and fish-eating in the latter part of the nineteenth century that there is a strong possibility that the causative factors of the disease may be dietary. However, most workers are of the opinion that the spread of leprosy in individual communities is attributable more to contact with open cases than to nutritional deficiencies. The authors have been working on the problem from the dietary aspect but as yet their findings are in general still inconclusive, and therefore they confine their report to a single observation regarding the value of a wheat diet in the relief of painful neuritis and certain joint pains. The experiments were carried out to test the suggestion that excessive consumption of carbohydrates may be responsible for metabolic imbalance. Wheat was therefore substituted for rice in the diet of the patients.

Thirty-seven cases were examined, and in every case where the wheat diet was consumed for three months or more, there was either complete relief or substantial alleviation of the painful symptoms. One curious difficulty experienced during the course of the work was the great reluctance of the Indian patients to take wheat instead of rice. In some cases, even when relief had been obtained from the wheat diet, the patients insisted on returning to rice. For adults 21 ounces, and for children 12 ounces, were the amounts of wheat administered each day. Throughout the investigation, the patients continued to receive the standard treatment of the institution for leprosy.

Analysis of the results shows that of patients treated for bone pain, 85·7 per cent showed complete relief, and 14·3 per cent partial relief. The corresponding figures for nerve pain were 69·5 and 30·5 per cent. The authors point out that whereas there was a constant improvement in nerve pain, there was no corresponding improvement in the leprosy condition. In reply to the possible objection that there were no controls, they state that as none of the patients had responded to palliative treatment beforehand, they automatically constituted controls themselves.

In conclusion, the authors state that their experiments show that the new method is worthy of trial where previous remedies have failed. It should be tried as a therapeutic measure before resorting to operative methods for painful neuritis, except in cases where there is a marked swelling of the nerve-sheath and threatened abscess-formation. The method, in addition to the hydnocarpus treatment, does not appear to hasten the disappearance of *Mycobacterium lepræ* from the skin and mucous membrane of the nose.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND

THE fourteenth annual report of the Department of Scientific and Industrial Research, New Zealand*, includes the Minister's statement together with the report of the secretary, and the reports of the several research committees of the Council as well as reports on research work at the agricultural colleges, the Physical Testing Laboratory, the Dominion Laboratory, the Geological Survey Branch, the Dominion Observatory, the Magnetic Observatory and Meteorological Branch. Immediately on the outbreak of war, the resources of the Department were placed at the disposal of the defence authorities, the Ministry of Supply, and the various controllers operating thereunder.

Investigations relating to problems of supply, increase of production and conservation of natural resources were initiated by the Department itself. The campaign against plant diseases and insect pests has been intensified and in view of the importance of soil survey to land development, those in progress are being accelerated as much as possible and a survey of the soil of the North Island is already well advanced.

A new industry which is now well on the way to successful establishment is the production of linen fibre. Prior to the outbreak of war, investigations, both local and overseas, into the possibilities of establishing such an industry had been made with very encouraging results. Trial planting of selective varieties of linen flaxes in Canterbury showed that fibre of the desired quality could be successfully grown and would at the same time provide for a profitable diversification of farming practice. Further developments in the war cut off the supplies of linen fibre formerly obtained by Britain from European sources, and an appeal was made to the Dominions to accelerate production of linen flax as rapidly as possible to help to meet the deficiency.

The Department is giving special attention to methods of storing fruit and dairy produce designed to meet emergency conditions. The research carried out on the cold storage of fruit has covered refrigerated gas storage of apples, the effect of fertilizers on storage quality, and wastage in citrus fruits. A programme of orchard storage experiments designed to give information to enable the best methods of non-refrigerative storage to be adopted, is also planned, as well as the erection of a semi-commercial scale refrigerated gas store. Close liaison has been established with the Department of Industries and Com-

* New Zealand. Fourteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 100. (Wellington: Government Printer, 1940.) 2*s*.

merce through an inter-departmental technical committee upon which both departments are represented with the view of examining New Zealand's local resources of minerals and all other raw materials with the view of supplying substitutes for those materials which are more difficult to obtain or are unavailable as a result of the War.

The Geological Survey has carried out quantitative surveys of deposits of such minerals as bentonite, manganese, chromite, clays, refractories, oil shale, sulphur and coal which are of special industrial importance at the present time. The Survey has also actively assisted the Mines Department and various companies engaged in the exploration of the potential petroliferous areas of the Dominion.

The detailed survey of New Zealand's coal resources is being further extended and the necessary chemical investigations have been carried out in the Dominion Laboratory, which has also undertaken special work in relation to the gas storage of fruit as well as investigations of substitute fuels for use in emergency. The Research Associations for Leather and Shoe Manufacturing and the Wool Manufacturing Industries have given special attention to maintaining the standard of quality of the products of these industries. Through these associations very great help has been rendered in technical problems arising from the greatly increased demands to meet Government contracts as well as supplying the ordinary requirements of the trade. On the outbreak of war, the Meteorological Office and Apia Observatory were immediately transferred to the control of the Air Department for the period of the War so that the service supplied by this office should be primarily available to the defence forces. The Department has also compiled a register of the scientific personnel of New Zealand and the detailed information thus obtained has already been of real practical use.

The Dairy Research Institute has continued its research in cheese-making, particularly on the determination of methods of preventing the failure of cheese starters in factories as well as on butter-making, including the keeping properties of butter and the hardness of butter. The Plant Research Bureau has continued its work on the development of pure and smut-free seed-wheat and has also made important contributions to the establishment of the linen flax industry. The Plant Diseases Division has been concerned with work on the diseases of cereals, Brassica, grass and tomatoes, etc., as well as seed disinfectants, copper sprays, both in the field and in glass-houses. The results obtained with copper sprays indicate that so far none of the Bordeaux substitutes is equal to Bordeaux mixture in disease control when compared on the basis of equal concentrations of copper. Excellent control of tomato leaf mould has been obtained with Shirlan *AG* in glasshouse tests under commercial conditions. The Plant Chemistry Laboratory has been responsible for work on the cyanogenetic glucoside of white clover as well as on plant hormones. Fruit research of the Department has covered fertilizer experiments on apples, the biological control of woolly aphis, chemical control of various insect pests such as red mite, leaf hopper, and bronze beetle, biological studies of mouldy core of apples and spraying experiments. Tobacco research has also included experimental work with fertilizers, investigations on mosaic and on collar rot disease, on the damping-off fungi, and on the effect of steam sterilization of the soil on seed germination.

FORTHCOMING EVENTS

Thursday, October 17

INSTITUTE OF FUEL (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.15 p.m. Mr. W. M. Selvey: Presidential Address.

Friday, October 18

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne), at 6 p.m.—Annual General Meeting. Mr. W. A. Woodeson: Presidential Address.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHER OF SCIENCE, MATHEMATICS AND TECHNICAL DRAWING at the County Technical School, Halesowen—The Director of Education, Education Office, County Buildings, Worcester (October 17).

HEAD OF THE BUILDING DEPARTMENT and LECTURER IN CIVIL ENGINEERING—The Secretary, Technical College, Sunderland (October 21).

LECTURER IN ELECTRICAL ENGINEERING AND PHYSICS—The Clerk to the Committee of Management, Technical College, Shrewsbury.

WIRELESS ENGINEER for the POSTS AND TELEGRAPHS DEPARTMENT, Gold Coast—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/5976).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Home Security. Air Raid Precautions Memorandum No. 16: Emergency Protection in Factories. Pp. 8. (London: H.M. Stationery Office.) 1*d.* net. [259

Medical Research Council. Bulletin of War Medicine. No. 1, September. Pp. iv+64. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [309

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 19: The Effect of the Inhibition of Respiration and Assimilation of the Diatom *Ditylum Brightwelli* (West). By Dr. D. Bhatia. Pp. 245–259. 1*s.* 3*d.* Vol. 60, Part 3, No. 20: The Structure and Behaviour of the Chromosomes of the Sheep during Mitosis and Meiosis. By I. A. Ahmed. Pp. 260–270. 1*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [309

War-Time Problems: Training Industrial Workers. Pp. 12. (London: National Institute of Industrial Psychology.) 3*d.* [309

Ministry of Health. Memorandum on Measures for the Control of Mosquito Nuisances in Great Britain. By Lt.-Col. J. A. Sinton and P. G. Shute. (Memo. 238 Med.) Pp. 30. (London: H.M. Stationery Office.) 6*d.* net. [210

Other Countries

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NATURE

Vol. 146 SATURDAY, OCTOBER 19, 1940 No. 3703

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MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number : City 4211

Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 19, 1940 No. 3703

FUNDAMENTALS IN POST-WAR RECONSTRUCTION

HOWEVER great the horror and detestation with which the aims and methods of Nazi Germany may be viewed, it must not be forgotten that they have sufficed to raise a crushed and despondent people to take a place once more among the Great Powers, even though it has ceased to play any part in affairs beyond that of a powerful and firmly welded instrument designed for and directed solely to domination. Whereas Great Britain and her allies hold fast to a faith rooted in belief in the essential dignity of mankind, a dignity which can attain full stature only in a world in which freedom and justice are the guiding principles, it must constantly be kept in mind that, over against that ideal there stands another, an ideal of service and self-sacrifice in the interests of the group or State, which is, if anything, even more compelling and no less inspiring of devotion in its votaries than that to which we give allegiance. If we believe that the ideals of democracy and the cause of humanity will prevail in the long run over the narrower and cruder aims of a restrictive nationalism, and the totalitarian State which is bent on aggression and domination by force, it is incumbent upon us to justify that faith by showing that it has a more certain foundation than wishful thinking. On this the verdict of science claims to be heard.

Magna est veritas et praevalebit. But if truth, that is the reality of things, is to prevail in post-War reconstruction, where does it reside? Faith in the ultimate triumph of truth exacts that the settlement and adjustments that are to come should be in harmony with it; and the lasting character of the peace which will be made and the opportunities peace will afford for the advancement of mankind will stand in direct relation to the clarity we attain in our vision of its principles and essential nature. In Germany, in the last seven years, by the aid of the crudities and unwarranted interpretations of racial theory and the suppression of freedom of thought and research, the resources of science and its methods have been harnessed to the production of a certain type of mentality and a society wholly subservient and adapted to the creed of an aggressive, violently national, totalitarian State. Is it in this direction that truth lies?

Granting the difference in aim of a society that desires peace and the advancement of mankind, is the regimentation of the individual inseparable from the application of scientific truths to the problems of the well-being of the peoples of the future? In other words, is the democratic ideal of the freedom of the individual in thought and action compatible with the scientifically planned economy which, so far as can be seen at present, post-War conditions will demand as an essential condition of the survival of civilization and the rescue of large masses of the world's population from the effects of abject destitution? Democracy is notoriously slow to act, and in its anxiety to compromise in the interests of individual rights, not infrequently muddled in its decisions. Guidance of such a society along the paths to its welfare indicated by the results of scientific research is apt to enlarge the powers of the bureaucrat. It must seem, therefore, that one of the first problems to be resolved in post-War society, assuming the survival of the democratic ideal, will be to reconcile the freedom of choice of the individual with the application of scientific principles which, it can be shown, are essential to the well-being of some or all the members of a

given community. Obviously one solution lies in education, and the more widely it is spread, and the greater its continuity, the more readily will the conflict be resolved.

Such questions, however, are a matter of machinery and leave the main principle untouched. In the interval between the two world wars of 1914–18 and of 1939, the course of events in world politics and economics was such as to lead many to think that the rapid expansion in the material development of the twentieth century, in which science has played a preponderant part, has masked a very real check in the intellectual and moral development of mankind. The optimism as to the capability of mankind for continuous development, which was characteristic of the nineteenth century, gave way to a pessimism which regarded civilization, at least in its Western form, as on the verge of dissolution. Such a pessimistic view, however, is unscientific and lacking in perspective. The more intensive the study of man and of human society, and the more precise the methods applied to these studies, the more clearly does it become apparent that, on a long view, the story of man physically, mentally, morally and socially has been on the whole one of continuous advance. To say this is to ignore neither the fact that advance in certain characters is now less readily discernible than in others, or that in specific instances great civilizations have risen and after a period of dominance have fallen into decay.

If it be accepted as demonstrable truth that, just as man, like other members of the animal kingdom, is the product of an evolutionary process, so also the social and cultural structure, which he has devised as the setting and means for the existence of the individual and the perpetuation of the race, the joint product of his brain and the necessities, physical and other, of his organism, is also the outcome of a development which may be regarded as closely analogous to the evolutionary process of the organic world. Without entering into details of the argument, it may be taken that recent application of the methods of research in social anthropology to problems of administration among backward peoples, more especially in Africa, has shown that if acute unrest and dislocation in the social organism is to be avoided, any attempt to promote the well-being of the people, whether by the introduction of a more advanced and efficient system of government or by raising the general standards in mode of life, must be adapted to the cultural stage of the community and must be in harmony with what, it might be anticipated, would be the natural trend of social and cultural development.

In the history of human society, progress in civilization would appear on broad lines to be largely dependent on two factors. It is rooted in the institution of the family, the most stable and, on the whole, the most effective agent for the early training of individual character; and secondly, it depends upon the degree to which the community, the greater unit within which the family exists, reproduces the conditions of the lesser unit in a consciousness of unity and the peaceful harmony with which its members are prepared to co-operate with one another. Further, it is a matter of observation as well as of historical record that the more extended the social unit in which conditions comparable to the family prevail—clan, tribe, people or nation—the greater the opportunities for the growth and development of the individual in conditions of social, political and economic tranquillity. That there have been exceptions by no means invalidates an argument which can be illustrated by reference to a line of development which has culminated in the British Empire, the movement towards unity of the two Americas, and would now seem to be at the point of being carried further in the approach to one another under stress of the two greatest English-speaking peoples of the world, the United States and Great Britain, with its American possessions and Canada.

In so far as these principles or rather trends in social and political development throw any light on the fundamentals of post-War settlement, they would appear to point to the necessity for continuous endeavour to create larger and even larger unities, which both internally and externally would work for the preservation of peace by eliminating inter-group political, social, and economic competition and rivalry. The League of Nations was an attempt to create such a unity, but it failed. The post-War settlement which followed the War of 1914–18, in the attempt to restore the *status quo ante bellum*, erred in stressing the small group, and by fostering rights of self-determination opened the way to racial and national self-assertion and rivalry. Contrast its political failure with its success in the fields of scientific research, social reform and intellectual co-operation, in which national and racial barriers were ignored.

The League might have been saved from a

second mistake had greater heed been given to the cultural traditions of the peoples whom it was sought to include in a close bond of union. It brought within its fold not only nations of very varied cultural history in northern, western, eastern and southern Europe, as well as South Americans long removed from European tradition, but also peoples at varying stages of cultural development. As a result, when Abyssinia was attacked, a State that many regarded as semi-barbarous, the League showed itself impotent. Unity of action was unattainable. The failure up to the present to secure co-operative effort in India is held by many to be due to a failure to appreciate the difficulty of applying advanced political ideas to a situation conditioned by the varied stages of social development of the population, which have not in any instance yet attained a point at which the democratic ideal can be fully grasped.

So far as a post-War world is concerned, the first lesson of the past history of social development appears to be that we must not look for any return to the *status quo*. The future line of development lies in the direction of the formation of larger and larger political and social entities, among whom peace will be secured by co-operation, good will and a common interest in the advancement of humanity, as well as the elimination of political and economic rivalries. At the same time, regard must be paid not only to differences of cultural tradition, for these indeed will make a useful contribution to the common stock of ideas, but also to differences in the stage of cultural advancement, lest incompatibles be held in too close a bond of union which friction and lack of understanding will disrupt. Too frequently the impact of two widely diverse cultures has brought about friction, disintegration and retarded development. Hence the difficulty which confronts any attempt to form a federated Europe which necessarily must include States of backward peoples, as well as the more advanced. A system of zoning or grouping of compatibles must be devised.

It is evident that, if the trend of development in the future of human society can be determined thus with reasonable probability, the Nazi aim of a dominant Aryan people ruling the subject and inferior races of a united but conquered Europe is retrograde and contrary to the trend of social 'evolution'—a reversion to the medieval conditions of the period of migrations.

On the other hand the democratic ideal does at least allow for that free play of ideas essential to a progress which in the long run will conform to the truth as we see it—a harmony with the evolutionary process.

THE PLAIN MAN AND GOD

God in a World at War

By John Hadham. Pp. 96. (Penguin Special S.73.) (Harmondsworth and New York: Penguin Books, Ltd., 1940.) 6*d*. net.

THE object of this little book is not to argue, "but only to state a belief in God in terms which any man can understand". In this it has certainly succeeded, though a belief in God which is understandable is not necessarily credible. Still, unless a belief in God is put in intelligible terms, it is not likely to be effective, even if true. As Mr. Hadham says, "God cannot be made real by the irrelevant accuracies of metaphysics"; and this is all the more the case when these irrelevancies are inaccurate. One of the things from which we are suffering to-day is "that all the conventional descriptions of God were written by men who held totally different views of the world, of human society, and of the nature of the individual, from that which we now hold." These descriptions were valid enough at the time they were written, but the permanence of such validity was dependent on the permanence of the views in terms of which they were made; and the terms are now quite obsolete and not so much incredible as meaningless.

Of course the trouble is that when you make a profound idea understandable you may sacrifice its profundity. For example, in his desire to make it clear that God is personal, Mr. Hadham may seem to many to present us with a deity with strong resemblances to Mr. Henry Ford, or perhaps to Mr. Gladstone. It may be true that "God is a person, and is best described and thought of by the ordinary person in purely personal terms"; but it will not do to regard God as a magnified and non-natural man. That is almost worse than theological mumbo-jumbo. Even the ordinary man cannot be relieved of the painful necessity of asking himself, when he is told that God is a person, what

do I mean by a person? Mr. Hadham is not helpful here because he rather condones the popular view that metaphysics is a mystery, and not just the pursuing of ordinary questions to their ultimate limits. If a man asks himself what a person is, he may end by regarding personality (as the Oriental religions do) as a limitation rather than as a goal. Religion may even consist in trying to transcend or pass beyond personal existence with its desires and fears. Is not the *ego* a limitation, a prison, a barrier dividing us from God? Even Christian mystics seem to have suggested this. If this is so, is Mr. Hadham really on right lines with his activist, common-sense religion? It is of course far better than the "churchianity" he treats with such vitriolic contempt, but that, surely, is not to say much.

But the virtue of this book consists in the fact that it does supply the plain man with a version of Christianity which he can at any rate understand and endeavour to practise. Most people who lapse for good causes or bad from organized religion become for practical purposes secularists. But there is no reason why they should, if they read this able, sincere, and highly readable book.

J. C. H.

THE PHYSIOLOGY OF REPRODUCTION

Recent Advances in Sex and Reproductive Physiology

By Dr. J. M. Robson. Second edition. Pp. xiii + 329. (London: J. and A. Churchill, Ltd., 1940.) 15*s*.

It is six years since the first edition of Dr. Robson's "Recent Advances" was published, and in the interval great progress has been made in sexual physiology and in particular in the study of the sex hormones. The principal results of the newer work have been successfully incorporated in the second edition, and the author is to be congratulated on having achieved a not very easy task. In reviewing the first edition it was pointed out that the title was somewhat misleading since the work dealt almost exclusively with the sexual and reproductive phenomena of the female organism, omitting the work done upon the male. This criticism has now been met, for not only has a new chapter been added on the male hormone and other androgens, but also such subjects as "cycle changes in the male", the "assay of androgens", and other contributions to the physiology of the male sex have been incorporated in the appropriate parts of the book. Moreover, there are additional chapters on the chemistry of the hormones and on the methods used in their standardization and the determination of their activity.

The least satisfactory chapter in the book is probably that on the maintenance of pregnancy and the initiation of parturition, but this is not due so much to the author's treatment as to the inherent difficulties of the subject, resulting from the apparently contradictory evidence and the great amount of species variation. Nevertheless, although recognizing the antagonistic action of oxytocin and progesterone as shown by the fact that uterine response to the former is decreased by the presence of the latter, the author fails to give full weight to the evidence on the point as presented by Dr. Knaus in his work on "Periodic Fertility and Sterility", a book which is referred to in another chapter.

In a chapter on the function of the pituitary and its relation to the gonads, the neural factors regulating the cycle are dealt with rather inadequately. The work on the "Hypothalamus and Central Levels of Autonomic Function", recently issued by the Association for Research in Nervous and Mental Diseases, no doubt appeared too late for consultation, but only a very few of the papers quoted in the articles by Drs. Brooks, Bard, and Uotila, are referred to by Dr. Robson. This is unfortunate, as the recognition of the important part played by exteroceptive factors in sexual periodicity is among the recent advances of generative physiology. It is true that some of the most beautiful examples of such phenomena are to be found among birds and lower vertebrates and that Dr. Robson's work confines itself to mammals. Nevertheless, with mammals of certain species the evidence of neural control is very evident, but only a few examples of this are cited. Dr. Harris's work on the production of pseudo-pregnancy in the rat (an animal which ovulates spontaneously) as a result of electrical stimuli is omitted, and there is no account of the numerous experiments by different investigators on ovulation in the rabbit as a result of stimulating substances acting on the pituitary or on the hypothalamus. The statement that electrical stimulation of the cervical sympathetic ganglia produced ovulation is now known to be erroneous, as has already been pointed out in several papers. It is to be hoped that greater prominence will be given to the subject of neural control in the third edition, which will be doubtless called for in a few years.

F. H. A. Marshall.

ASIATIC YAMS

An Account of the Genus Dioscorea in the East

(Annals of the Royal Botanic Garden, Calcutta, Vol. 14.) Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. Pp. viii+211–528+xx+plates 86–150. (Alipore: Bengal Government Press, 1939.) 67 rupees; £5.

YAMS must have been one of the foods of primitive man, and in their wild state they still form one of the chief components in the diet of jungle tribes; indeed, in times of failing rainfall and consequent scarcity, they rise to a prime importance for the survival of individuals in remote tracts. These tubers are commonly found at a considerable depth underground, sometimes as much as five feet, and are often protected against the depredations of wild animals, principally pigs, by thorny growth above the tubers themselves. Considerable labour is demanded for their extraction, especially in times of duress when drought has hardened the soil. The wild man's tools are of poor quality, and it is at such times that the curse of Adam lies heavy on the untutored savage.

At what stage in this evolution, and by what chain of circumstances early man began to realize that he could make his life easier and more secure by growing his food artificially, and by what slow degrees he achieved this purpose, is a fascinating, if not very fruitful, subject for speculation. But achieve it he did, and in so doing he improved the quality and quantity of the yield by bettering the conditions under which it was grown, and by conscious or unconscious selection. Was the first step the result of a flash of genius in one man or a slow process growing up by accident? Presumably we shall never know. Under cultivation the size and shape vary very greatly in the same species, as can be seen from plate 125 of this work, where no fewer than 72 different forms of the tubers of *Dioscorea alata* L. are figured.

As is the case with many cultivated plants, it is not possible to state definitely where certain yams, now well known, are truly indigenous, even though it is known in what localities they are growing spontaneously. Some yams have poisonous properties when raw and have to be prepared accordingly before they are fit for human consumption.

The first part of this monograph, dealing with the species which twine to the left, was reviewed in NATURE of January 29, 1938, and a portion of the present part in that of November 25, 1939. In the latter survey it was pointed out that the systematic matter was not yet published. The full part has now been issued, and the whole of this noble contribution to botanical science is available to those interested.

The systematical portion of this part deals entirely with the section Enantiophyllum—the species which twine to the right. It comprises seventy-six species, that is to say, a few more than the sum of all the other sections. In it is included the most important species from the point of view of food material—*Dioscorea alata*, Linn. This yam has been very widely cultivated, not only in the East, but also in Madagascar, many parts of Africa and in the West Indies.

A simple and easily applied key to the species is provided and also keys to the varieties where subdivision calls for them. A full description of every aspect is given for each species, together with complete synonymy and references to literature. The herbarium specimens examined are listed under the subregional scheme adopted by the authors. All this, however, is not the sum total; a comprehensive history of each species is recorded with a discussion of the significance of the vernacular names applied to it; the uses are detailed, with information on cultivation and the preparation of the yams and bulbils for consumption. One feels that the authors have followed up every clue with the pertinacity and acumen of a criminal investigator, bringing to light every fact possible for the compilation of a complete 'dossier' for each species. The resulting production, moreover, is as entertaining to the discerning reader as the pages of a 'thriller'. In short, this monumental achievement can claim to be an exhaustive account of the Dioscoreas of the East, and it seems difficult to believe that anything is left for further investigation.

In the course of their researches the authors have found it necessary to make no fewer than seventy-four new species, one more than had been hitherto published. These have all been described previously in the pages of various journals; the great majority in the *Journal of the Royal Asiatic Society* or in the *Kew Bulletin*.

The sixty excellent drawings (besides three photographic reproductions and three plates of locality maps), are the work of several artists, but nearly one half are from the pencil of the junior author.

C. E. C. Fischer.

A GERMAN ZOOLOGY

Handbuch der Zoologie
Eine Naturgeschichte der Stamme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Band 3: Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lieferung 12. Pp. 160. 22 gold marks. Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lieferung 13. Pp. 128. 18 gold marks. (Berlin: Walter de Gruyter und Co., 1939.)

THESE are the last two parts of this now well-known "Handbuch" to be received in Great Britain and it seems likely that no more will be received for some time.

The first is illustrated with 288 figures, only three of which are original, but they are well chosen and well reproduced so that they form a useful collection. The text continues the account of the Araneæ by Prof. U. Gerhardt and Dr. A. Kästner, and concludes the description of the embryology already commenced in the preceding part. It passes on to deal with the ecology, web spinning, reproductive phenomena, stridulation and moulting. Two pages are devoted to a discussion of the phylogeny before passing on to the classification and systematic review which occupies 78½ pages. The last 8½ pages are devoted to the bibliography, and so this part terminates the account of the Araneæ. The Liphistiidæ are regarded as the oldest of the spiders.

In the second part, 29 of the 120 illustrations are original, and the idea of illustrating individual species by a series of photographs of good specimens rather than by drawings has proved a most successful one. The first 3½ pages finish the bibliography of Prof. C. J. Cori's account of the Phoronidea, and the remainder of the part, with the exception of 4 pages of index at the end, is devoted to Dr. J. Gerhard Helmcke's treatment of the Brachiopoda. It includes a description of the shell and skeleton and of the anatomy, histology and development of the group. Short accounts of the physiology and ecology precede a somewhat longer one of the geographical distribution, particularly in relation to the ocean currents. As in other groups, the account ends with the systematics and a list of the literature. For conciseness and compactness of treatment this part on the Brachiopoda might well have served as a model for the accounts of some of the previous groups, which tended to be prolix and discursive.

It is no small praise to the authors, editors and publishers of these two parts to say that they worthily maintain the standard of the "Handbuch".

AGRICULTURAL INDUSTRIES

The Agricultural Industries
By Prof. Deane W. Malott and Boyce F. Martin. Pp. viii+483. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 26s.

IN the early agricultural systems the production and processing of food, drink and clothing was carried out within the farmer's family. It is a feature of a developed agriculture that the cultivator finds full-time occupation on the land, handing over his product to form the starting point of associated industries of ever-increasing extent and complexity. The United States offers an extensive field for the study of the economic and technical problems which these agricultural industries present; for in that country the manufacturing and processing industries based on agricultural raw materials account for no less than 15 per cent of the total industrial output and employ nearly a million people.

The basis of the book is a course of instruction in the agricultural industries given by the authors at the Harvard Business School, and a great deal of supplementary information has been supplied from the many trade experts whom the authors have consulted.

A systematic treatment is adopted. Each of the main industries forms the subject of a lengthy chapter. The types of raw material and methods of production are first dealt with. Then assembly, transport and marketing organization are described and discussed. The authors pass on to the financing and business organization of the industry, and set out the aims and results of the legislation that has been imposed on almost all branches of agricultural production and marketing to meet the economic changes of the past few years. A critical appraisal of the problems of the industry concludes each chapter.

The first section deals with the dairy industry, for the cash receipts from milk by United States farmers are greater than from any other agricultural

commodity, and more than three times as large as from wheat. The struggle between producers and distributors around the question of the milk price, with the ultimate adoption of control, has followed the course familiar to English readers. Next comes an account of the livestock industry; the historical sections dealing with the development of livestock farming and the meat packing industry being particularly interesting. Chapter iv is devoted to cotton, and the efforts made by the Government to control surpluses and institute orderly marketing are set out in tabular form covering the period from 1929, when the price decline of American cotton became really serious, until 1939. Occasionally, as in 1937, the bounty of Nature outweighed all restrictive schemes and threatened to bring confusion to the industry.

The extent of the sugar industry in the United States is sometimes overlooked in Europe. The fact is that the output of beet sugar alone is more than twice that of Great Britain, to say nothing of a considerable production of cane sugar. The organization of this industry is discussed in Chapter vi.

Other chapters deal with tobacco and wool. In their concluding section, discussing the relationship of the problems of the farm to those of the agricultural industries, the authors stress the need for grappling with the problems of surpluses, and look to the development of new industries based on new crops to take the place of redundant acres of the older ones. At the same time the processing trades should search for new outlets for the standard crops.

ARCHÆOLOGY IN THE EASTERN MEDITERRANEAN

The Annual of the British School at Athens
No. 37, Session 1936–37, Papers presented to Prof. J. L. Myres in honour of his 70th Birthday. Pp. x+286+31 plates. (London: Macmillan and Co., Ltd., 1940.) 42*s*. net.

It is a striking tribute to the work and personality of John Linton Myres that the contents of the thirty-seventh issue of the Annual of the British School of Archæology at Athens consists, not as is usual, of records of research work of members of the School in the year under review, but of a number of papers presented to him in honour of his seventieth birthday by fellow workers in the field of the archæology and early history of the Eastern Mediterranean. A larger number of friends and colleagues, of whom a list is given, have contributed towards the cost of publication. It is appropriate that the British School should delight to honour one who is chairman of its Committee of Management, has been a staunch supporter of its work throughout the greater part of its existence, and is one of its students of longest standing. There will be many who will regret that the circumstances have precluded the inclusion of a like tribute from those whose province lies in other fields of learning and inquiry in which Prof. Myres has achieved an eminence no less worthy of commemoration than his archæological studies in the Eastern Mediterranean.

The list of contributors, needless to say, includes many distinguished names, of whom a few only can be mentioned here. Dr. C. W. Blegen reviews the evidence of the excavations of the expedition of the University of Cincinnati, 1932–38, on the site of Troy in its bearing upon the dating of the various settlements and their contacts with the Early, Middle and Late Bronze Age in the Ægean. An impromptu lecture by Prof. A. W. Brøgger, delivered while on a tour in the *Cairo City* in 1939, on "The Vikings of the Mediterranean and the Vikings of the North", dealing with the cultural influence of sea-power, so impressed its audience as to achieve here a well-deserved permanent record. Prof. V. Gordon Childe also deals with a field which he has made peculiarly his own in "Neolithic Blackware in Greece and on the Danube". An interesting and pertinent topic is examined by Prof. R. M. Dawkins, who traces the process of tradition in Greece in so far as it affects legends dealing with such supernatural happenings as no one is likely to regard as true. An interesting communication by Dr. P. Diaios, which is of added importance for its bearing upon ritualistic and cultural relations, describes an iron age painted vase in the Cyprus Museum, the product of illicit excavation but saved for archæological science, the decoration of which, a ritual of drinking through a siphon, points to a connexion with Syria.

The wide range of interest covered by other papers to which detailed reference cannot be made in a brief review may be suggested by the fact that they extend from western Europe (Prof. H. J. Fleure on the rough stone monument) to Palestine (Prof. D. A. E. Garrod on decorated mesolithic skeletons), and the Anatolian Plateau (Dr. H. Z. Koşay on excavations of the Turkish Historical Society in the copper age levels of Alaca-Höyük).

ALLOYS OF IRON AND CHROMIUM

The Alloys of Iron and Chromium
Vol. 2: High-Chromium Alloys. By A. B. Kinzel and Russell Franks. (Alloys of Iron Research: Monograph Series.) Pp. xv+559. (New York and London: McGraw-Hill Book Co. Inc., 1940.) 40s.

THE Alloys of Iron Monographs, arranged by the Engineering Foundation of the United States, constitute a valuable series. The alloys of iron and chromium have taken up two volumes; volume 1, by Kinzel and Crafts, dealt with those alloys containing less than 10 per cent of chromium, and now volume 2, by Kinzel and Franks, deals with those alloys containing more than 10 per cent of chromium. The volumes are claimed to be a review and summary of published information and available unpublished data. A careful study of both volumes shows that the work has been well done, and a service of the first order rendered to ferrous metallurgy. The scientific and technical literature covering this field is so extensive now that for those who have not grown up with the subject the systematic study and analysis of available data which the authors have achieved is most valuable.

The investigation and technical exploitation of the iron-chromium series has led to the availability of a very valuable series of rust-, acid- and heat-resisting steels, which have greatly assisted modern engineering developments in many widely dissimilar fields. The explanation of this great achievement is that the addition of a sufficient amount of chromium to iron confers upon the iron the property of producing spontaneously upon its surface a passive and resistant film as a result of contact with the atmosphere or with certain aqueous environments. Such passive films, if mechanically damaged, are self-repairing. The quality of resistance of the film is advantageously affected by increasing the chromium content, and as regards quite a wide range of corroding media, by the addition of other elements, such as nickel, molybdenum, tungsten, copper, titanium, etc. It has also been shown, but is not mentioned by the authors, that the corroding medium also, in a very interesting manner, takes a definite part in producing the particular type of film by which it is resisted; as regards the type of film necessary in the case of some corroding media, the formation, whilst taking place with sufficient rapidity for successful technical employment, cannot be regarded as being spontaneously produced. Turning to steels which operate at high temperatures, the oxide film is progressively thickened for a time, and then appears to become stabilized as regards resistance to further thickening. It will be seen that the whole field has presented, and indeed still presents, a great experimental ground for the investigator and also for the practical technologist as regards extended applications.

The authors, in endeavouring to present to the student some account of all published and available work, whilst being largely successful in that object, have almost necessarily given space to both technically interesting and technically uninteresting alloys, and it would have been an added value to the volume if indication had been given in a more definite manner of the extent two hich different alloys had found their particular niche in wide industrial application.

For certain data, fundamental to all ranges of the iron-chromium alloys, it will be necessary to refer to volume 1 (Kinzel and Crafts) which, although directed particularly to a study of the low-chromium alloys, deals with such aspects as the history of the chromium steels, the preparation and properties of chromium metal and ferro-chromium, the constitution of the iron-chromium alloys and the general effects of chromium in iron and steel. In the present volume, after referring briefly to the metallurgical fundamentals of stainless steels, the authors describe the melting of the high-chromium steels and discuss the methods which have been developed to overcome the particular problems which arise in the process, owing to the high affinity of molten chromium for carbon. In the subsequent chapters, the fabrication and properties of the various types of high chromium steel and cast iron, and the effect of alloying additions are dealt with systematically, including the extremely important rich chromium-nickel-iron alloys, and the less important chromium-manganese-iron and chromium-aluminium-iron alloys. The work is principally a correlated summary of published data, rather than an expression of the authors' personal and critical findings.

On page 86, under the heading "Effect of Tungsten", we find the statement: "Steel containing 0·12 per cent maximum carbon, 12 to 14 per cent chromium, and 2·5 to 3·5 per cent tungsten, has been proposed for oil cracking service. This material is said to have higher useful strength at elevated temperatures than similar material containing no tungsten, but no data are available". It seems somewhat strange that the

authors should have overlooked the following data given in Thum's "Book of Stainless Steels" (second edition), pp. 264–265 : "the American Iron and Steel Institute has issued a standard type No. 418 for the nominal composition 12 to 15 per cent chromium 0·12 per cent max carbon and 2·5 to 3·5 per cent tungsten. W. J. Teemer, of Allegheny Steel Company, kindly forwards the following physical properties of metal conforming to the above type number (manganese and silicon both under 0·50 per cent)". Thereafter follow data derived from a series of creep and short-time high-temperature tests carried out at temperatures varying between room temperature and 1400° F. On page 90, for Chapter xvi read xv. On page 292 it is interesting to note that an 18/12 steel is recommended for severe deep drawing. One would have expected the 12/12 steel to be recommended.

It is in regard to low-temperature tests that the most serious inaccuracies have been noted; for example, on page 341 reference is made to Izod impact tests carried out at low temperatures by Colbeck and his associates, on a steel containing 0·13 per cent carbon, 17·80 per cent chromium and 7·97 per cent nickel, but no reference to a steel of this analysis can be found in the original paper. Again, on page 342, data are quoted from a paper given by De Haas and Hadfield (*Phil. Trans. Roy. Soc.*, A, **232**, 297–332; 1932). The figures quoted are inaccurate, the correct values being as follows:

	Testing temperatures	
	20° C. (70° F.)	−252·8° C. (−423° F.)
M.S. tons/sq. in.	52·4 (117,400 lb.)	119·8 (268,400 lb.)
Y.P. tons/sq. in.	25·9 (58,000 lb.)	55·8 (125,000 lb.)

On page 368, table 113, first line of the third group, for 79·92 read 74·92.

To one deeply interested in the subject it was natural to look to the index to see what the book contained concerning passivity, the passive film, the sigma phase and contact corrosion. It is always a great advantage in a book of reference of this character to have a complete index, and it is therefore surprising that help is not given to locate the relevant information. The passive film theory is dealt with to some extent, but there appears to be no reference to the very curious phenomenon of intermittent passivity.

There is no doubt that this volume will prove a very useful addition to the technical library, and as regards the text, there appears to be very little to which exception can be taken. It is a very big undertaking to handle critically the large number of papers now extant in this field, but, nevertheless, the authors are to be congratulated upon the extent of the success which they have achieved.

There is an excellent bibliography of the subject consisting of more than five hundred references.

W. H. Hatfield.

HYDROCARBONS

(1) Physical Constants of Hydrocarbons

Vol. 2: Cyclanes, Cyclenes, Cyclynes and other Alicyclic Hydrocarbons. By Gustav Egloff. (American Chemical Society, Monograph Series No. 78.) Pp. 605. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 72*s*. net.

(2) Conversion of Petroleum

Production of Motor Fuels by Thermal and Catalytic Processes. By Dr. A. N. Sachanen. Pp. 413. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 36*s*. net.

To the chemist the word hydrocarbon defines a particular group of substances, to the public the equivalent word petroleum signifies motor fuel and motive power. To-day, when the destruction of the oil supplies and reserves of the enemy is the primary object of our bombing raids, it is interesting to reflect on the enormous technical advances in the petroleum industry largely due to the application of scientific research and the extension of scientific knowledge. Probably no industry has done more to encourage research and development than that of petroleum, and it has been richly rewarded. In particular the speed of the development has been amazing.

Whereas in early days straight-run products, that is, selected fractions of a simple distillation, were the rule, at a later stage these were augmented by cracking the higher boiling residues, and to-day thermal and catalytic processes have been brought in both to augment the yield of motor spirit and to give to it a quality which enables the modern engines which use it to produce such amazing speeds in aeroplanes and elsewhere.

(1) Egloff's book is the second volume to appear of a four-volume series in which the physical constants of hydrocarbons are collected. The first was reviewed in Nature of March 23, 1940, and covered the open straight- or branched-chain hydrocarbons; the second deals with the cyclanes or closed-chain compounds, which the author tells

us amount to about one quarter of the total world production of oil. A brief and well-written introduction deals with the nomenclature of alicyclic hydrocarbons, which is in a confused state. The author has set out rules based on the Geneva Nomenclature Conference of Organic Chemistry with his comments, and uses the terms cyclanes, cyclenes and cyclynes for cycloparaffins, olefines and acetylenes respectively.

The tabular text is broken up into sections listed in the table of contents; each substance has its formula clearly set out and references are given to the original literature for each physical constant.

(2) Sachanen's monograph, which is likewise of trans-Atlantic origin, is a timely exposition of the principles and methods of the production of high-octane fuels. The subject is so extensive that the scope of the book has had to be limited, and consideration of the vast patent literature has been omitted as well as any account of the historical development.

Whilst thermal cracking remains the most important process in the conversion of crude oil into motor spirit, the newer processes are coming more and more to the front, including those dealing with refinery gases.

This is a book essentially for the petroleum technologist, and criticism in detail of the author's method of treatment of the problem is best left to a more technical journal. The chemist at large will gather from it the enormous amount of scientific work which lies behind the practical effort that enables us to buy a gallon of reliable petrol for our car. E. F. ARMSTRONG.

SCIENCE AND PSEUDO-SCIENCE IN POLITICS

Marxism

A Post-Mortem. By Henry Bamford Parkes. Pp. vii+246. (London: George Allen and Unwin, Ltd., 1940.) 7*s*. 6*d*. net.

THIS is a straightforward and readable criticism, written primarily from an American angle. The author describes how history has deviated from the path which Marx marked out for it; he shows up the dreary unrealities and illogicalities of the Marxian theory of value: he shares, in the main, with the orthodox economists and the neo-socialists, the conviction that extensive economic planning is incompatible with personal freedom, and that only under a free market system, where the consumer is king, can the public be well served with the goods and services of its choice; and finally he delivers a relatively mild attack upon the metaphysical foundations of Marxism.

Most of this has been said before. The author is perhaps most effective in his historical section, where he is also most concrete. He produces here some facts that are very awkward to assimilate in the orthodox doctrinaire Marxist analysis of contemporary society. Revolutions, for example, have proved themselves to be more at home among peasant than among industrial communities; and the industrial proletariat and its trade unions have shown markedly conservative tendencies, while the rise of a new middle class has thrown the Marxian class war right out of gear. Further, whatever else may have been accomplished by the professedly Marxist revolution in the Soviet Union, the level of prosperity and the range of personal freedom to be enjoyed there still remain behind that of States like Sweden.

The depressing thing is that there is so little reason to believe that this book will shake the faith of a single Marxist. For Marxism is a faith, and not a hypothesis based upon considered and precise observation of facts; and the root of the trouble is that social matters are still considered even by eminent men of science (many of them calling themselves Marxists) to be an appropriate sphere for faiths. What is wanted, in fact, is not just a post-mortem on Marxism, but a post-mortem on the whole apparatus of systems and 'isms' with which the study of social problems is cluttered up, and the substitution of an empirical, concrete approach. The job of the social organization is to see that people are properly fed, clothed and housed, and that they have opportunity to form mutually satisfying relationships with one another. Generalities about socialism, communism, fascism, Marxism and what-not now contribute very little towards the solution of these problems. These generalities are, in fact, mostly quite meaningless.

The whole approach to social and political questions is still pre-scientific. Until we have renounced tribal magic in favour of the detached and relentless accuracy characteristic of science, the unconquered social environment will continue to make useless and dangerous our astonishing conquest of the material environment. The weakness of Dr. Parkes's book, and of its many predecessors, is not that it does not say things that are sensible and true, but that the debate is conducted on the wrong plane. The abracadabra of Marxism will only be finally disposed of as an incident in a much more comprehensive mental revolution.

BARBARA WOOTTON.

THE EXTRA SPOTS OF THE LAUE PHOTOGRAPH

By Sir William Bragg, O.M., K.B.E., Pres.R.S.

Several workers have recently discussed the diffuse spots which often appear in Laue X-ray crystal photographs and do not belong to the Laue pattern proper. Thus Preston has given[1] illustrations of the spots in a number of cases and concludes that "the diffuse spots can be explained by the thermal vibrations of the lattice which break the crystal up into groups, consisting probably of an atom and its twelve neighbours. The thermal vibrations cause the interatomic distances to vary slightly from one group to another so that new diffraction maxima, characteristic of the group of atoms, are produced".

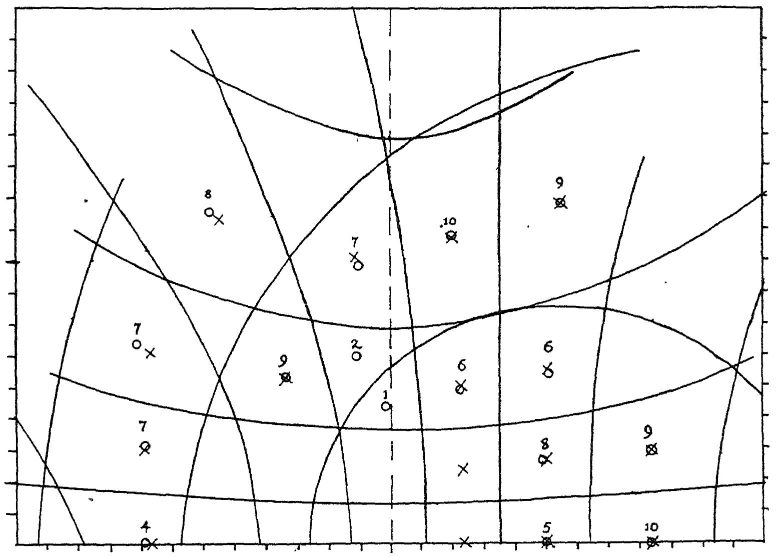

Fig. 1.

This diagram shows one half of the diffraction pattern referred to in the text. Observed diffuse spots transferred from the photograph are shown by crosses. Calculated positions are shown by small circles, and calculated intensities of maxima are indicated roughly by single figures. In the calculation of intensities no allowance is made for the effects of obliquity or of the dispersed arrangement of the scattering centres in the atoms.

If a pencil of monochromatic rays falls upon a group of scattering points in regular array in space, the diffracted rays take the form of a series of pencils which will produce a pattern on a photographic plate similar to the observed pattern of diffuse spots. The pattern so produced may be too weak to be observed; this will certainly be the case when the group is large enough. In the latter case, the crystalline arrangement of points must, as we know, be correctly oriented with respect to the incident ray. But when the group is small and there are sufficient groups which act more or less independently of one another and give a sufficient intensity in combination, there must be a diffraction pattern for all positions of the crystal containing the groups. The positions of the spots in the pattern are independent of the size of the group: and they change very slowly as the orientation of the crystal is changed.

Whether or no the spots of this diffraction pattern are actually the diffuse spots that are observed is a matter requiring proof. But at least it is worth observing how very accurately a calculation of the pattern predicts the positions of the spots and even to some extent their relative intensities.

It is, of course, true of a plane optical grating also that the positions of the diffraction maxima do not depend on the number of lines in the grating provided the spacing and wave-length remain unchanged. Nor do the directions of the diffracted pencils change much with the orientation of the grating. But there is no parallelism here to the characteristic crystal effect in which, when the number of atoms is large, observable reflection only occurs at definite orientations. This is a result of the three-dimensional arrangement. When the number in the group of atoms is small, the parallelism between the two cases is more complete.

A single illustration will illustrate the relation between calculation and observation. Suppose that a pencil of X-rays of wave-length λ, parallel to the z-axis, strikes a group of eight diffracting centres disposed at the corners of a cube of edge a. Let the cube be so arranged that one edge is parallel to the y-axis and two others are inclined at an angle θ to the axes of x and z respectively. In other words, the cube is tilted about the y-axis through an angle θ from a position symmetrical with respect to the axes. The tilt adds a complication to the problem which the hypothesis meets satisfactorily. The postulates of monochromatic rays and a simple cube can easily make way for more general cases later on.

The amplitude of the ray diffracted by the group of atoms in the direction hkl is then proportional to

$$\cos\frac{\pi a}{\lambda}\left\{h\cos\theta+(1-l)\sin\theta\right\}\cos\frac{\pi ak}{\lambda}\times$$
$$\cos\frac{\pi a}{\lambda}\left\{h\sin\theta-(1-l)\cos\theta\right\}.$$

It is somewhat laborious to calculate the positions of the various maxima of this expression, but the general lay-out of the diffraction pattern is easily found by putting each of the three factors of the formula in turn equal to zero. This gives three separate relations connecting h, k and l. The diffracted ray strikes the photographic plate,

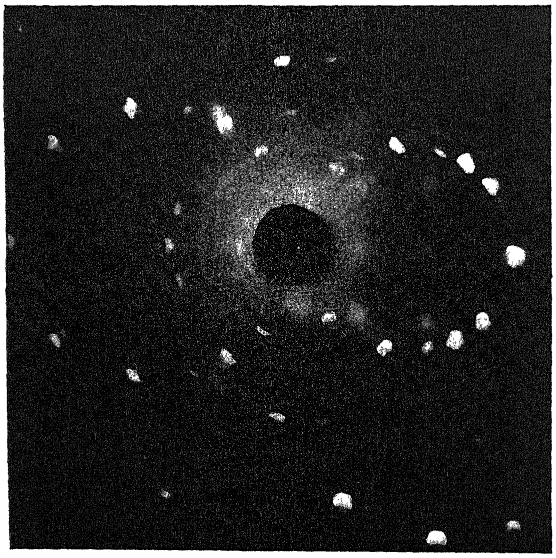

Fig. 2.
X-Ray photograph of potassium chloride; molybdenum α-rays; crystal tilted 20°.

which is normal to the direction of the incident, at a point defined by co-ordinates x and y, where $x = hD/l$, $y = kD/l$, D being the distance from crystal to plate. Expressing the three h, k, l relations in terms of x and y, we have three families of lines on the plate at every point of which the intensity of the diffracted ray is zero.

The accompanying figure shows these lines in the case when $\lambda = 0{\cdot}71$ A., being the wave-length of the α-ray of molybdenum, and $a = 3{\cdot}14$, being the length of the edge of a cube of potassium chloride atoms, four potassium atoms and four chlorine atoms lying at alternate corners. As potassium and chlorine atoms are very nearly equal in weight, the group of eight atoms corresponds well to the hypothetical group of eight diffracting centres, except that they are not point sources. The angle of tilt θ is 20°.

The zero lines are ellipses and hyperbolas. As the angle of tilt is not large, two of the sets of curves are roughly parallel to the axes of x and y. The third, corresponding to the third factor of the formula, is a set of ellipses. A point of maximum intensity lies at the approximate centre of each area enclosed by zero lines; at the outskirts of the figure the point lies nearer the origin than the centre of gravity of the area, an effect due to the obliquity of the rays.

This figure is to be compared with the actual photograph. It is not possible to bring out all the details of the photograph, and this is especially true of the spots on the left of the figure, which are very diffuse and relatively weak. Some of the spots are hidden by Laue spots. I fear, therefore, that the positions of some of the spots must be taken on trust. Their calculated and observed positions are marked in the figure. The generally close agreement is obvious. The rays of the photograph came from a molybdenum target, and were not monochromatic. Thus every wave-length forms its own diffraction pattern, and according to the hypothesis under consideration there must be streaks radiating outwards, the spots being the more intense portions due to the characteristic rays.

The spots in the photograph are not so diffuse as the formula would lead us to expect. But the formula is based on the assumption of a group of eight atoms only; if more atoms are included in a group, the spots become sharper. If larger and larger groups are taken into consideration, the total effect becomes less and less until at last the diffraction effect now considered disappears, the crystal becomes perfect, and observable reflection is only possible when the Bragg law is fulfilled. As already stated, the positions of the principal maxima do not depend on the number of atoms in the group; but as the number increases the lines of minimum intensity multiply in number and change their positions while retaining their general form.

The formula is derived on the assumption that the eight diffracting centres are points. Actually, the chlorine and potassium atoms are extended in space, and in consequence the intensity of the diffracted ray falls away as the inclination of the ray to the original pencil increases. The spots must therefore be weaker at the edge of the photograph than at the centre. The spread due to obliquity has an additional effect of the same kind.

That such groups of atoms can exist and have independent action does not seem unlikely. Similar associations in a liquid must produce rings and not a pattern of spots, because in a liquid all orientations are possible. In a solid, the orientations of groups are more restricted. The smaller

and the more numerous and the more independent are the groups, the more diffuse and also intense should be the spots. Perhaps in this way the effects of temperature can be explained.

The phenomenon of the diffuse spots has been discussed at length by a number of writers, but I venture to add this simple description of an effect which must exist whether it is observed or not. Faxen, in 1923, gave an explanation which relied on the existence of reflecting crystal planes in any zone, planes which could be correctly oriented for reflection even though one of the plane indices was incommensurable. He supposed that such extra planes could be produced by the passage of heat waves along the principal planes of the zone. In effect this gives the same result as a plane crossed grating, at least when there is no angle of tilt. That is because the unlimited choice of planes in a zone has removed the restriction of the three-dimensional arrangement. Zachariasen and Slater have examined the question more elaborately[2], and are conducting a series of experiments on the subject. So are Mrs. K. Lonsdale, Miss I. E. Knaggs and Mr. H. Smith, who have described their observations up to the present in NATURE[3]. To these last-named workers I am indebted for the photograph reproduced above. A discussion on lines which vary considerably from those taken by other workers has been given by Raman[4].

The positions of the extra spots in Raman's photograph of diamond can also be determined with accuracy by the method described above.

[1] *Proc. Roy. Soc.*, July 1939.
[2] *Phys. Rev.*, **57**, 597 and 795 (1940).
[3] NATURE, **146**, 332 (1940).
[4] *Current Science*, April 1940.

CHRISTIAN HUYGENS, 1629-1695

By A. E. Bell,

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THE central interest of Huygens' life and work may be said to be his relations with Galilei and Descartes on one hand, and with Newton and the English men of science on the other. Descartes and Galilei were the brightest stars in the scientific firmament at Huygens' birth, and they influenced him in one way or another all his life. When he died in 1695 his own star, though still bright, too quickly paled beside the brilliance of the ascendant Newton. A study of Huygens' collected works leads to the view that claims may well be made for wider recognition of the importance of his work.

Huygens' life came at a time just succeeding the long-prepared attack on Aristotle's science. His education was modern and included a study of the works of Archimedes, Galilei and Descartes, and the ardent Cartesianism of his famous father and his teachers profoundly affected his outlook. In fact Huygens was probably first stimulated in his scientific work by those writings of Descartes which Leibniz dismissed as "un beau roman de Physique". But without Huygens' researches Leibniz might well never have coined that phrase. Without Huygens, in fact, an important stream of scientific thought, instead of reverting to the methods of Galilei, might have followed Descartes to disaster. Nevertheless Huygens never completely forsook Cartesianism, no doubt owing to all the influences of his early years and partly perhaps because of his profound opposition to the law of universal gravitation and to the absolute space of Newton's "Principia". His scientific and philosophical position, indeed, cannot be indicated in a word, and a detailed consideration lies beyond the scope of this article.

Huygens is remembered for his discovery of Saturn's ring, his invention of the first practicable pendulum clock, his telescopic eyepiece and micrometer and his formulation of the wave theory of light. To these the historian would add his important researches on percussion and centrifugal force and his magnificent theoretical work concerning the pendulum clock (on the centre of oscillation of the compound pendulum and the proof of the tautochronism of the cycloidal pendulum). Then also there is his work on refraction at curved surfaces leading to general formulæ for lenses and lens combinations, the quantitative estimation of the effect of spherical aberration, the introduction of the concept of the optical centre of a thick lens and an important theorem containing the germ of the least action principle in optics. This leaves on one side his important work in pure mathematics, his lesser contributions to astronomy and his influence in the secure foundation of the Royal Academy of Sciences in Paris. Here we may concentrate on the main scientific conceptions he helped to establish in science in the course of these researches, and try to indicate why he became the "incomparable Huygens" to both Leibniz and

John Bernoulli, and "one of the chief Mathematick Luminaries of the present Age" to his English admirers.

The history of mechanics up to Huygens is really the history of statics. This is not surprising in a sense, for the first tendency, following the Neo-platonic revival of the sixteenth century which coincided with the decline of Aristotelianism, was to reduce most physical problems to geometry. Perhaps because of the absence of accurate time measurement, the time dimension scarcely entered into science. Even in Huygens' work, the geometrical method of presentation is dominant. In dynamics, however, the geometrical method was inadequate and Huygens had to invent his own procedure. He had, to start with, the law of constant acceleration of Galilei and its simpler deductions, the presumption of the law of inertia, the recognition of the vector nature of force (da Vinci and Stevin both obtained a proof of the parallelogram of forces) and certain ideas found in Stevin's work which may be said to have been the seed of a theory of virtual velocities. Galilei failed to relate force with motion and did not perceive the need of a distinction between mass and weight. The contributions of Descartes' brilliant but wrong-headed world-mechanism can only have served to confuse these questions.

Huygens' early studies were on the central problem of how motion is transmitted by impact. For this he introduced a famous device. He imagined a man standing in a boat which moves steadily with the stream. From his hands, spherical bodies of perfect elasticity are suspended by strings of equal length. In this way the bodies may be given any velocity in the direction of motion of the boat. With respect to a stationary observer on the bank and to the 'navigator' there are then two sets of co-ordinates on which to represent the motions of the bodies. Both representations are equally 'true'. Starting with certain self-evident axioms, Huygens was able, through this simple principle of relativity, to solve all the problems concerning impact between the masses whether equal or unequal. The correct formulation of the laws of conservation of momentum and of kinetic energy (*vis viva*) resulted from this work: mv and mv^2 (later modified to $\frac{1}{2}mv^2$) then entered physics with their modern significance. This involved a contradiction of all Descartes' work on the same subject and a revelation of his errors in the treatment of motion. Huygens treated mass as distinct from weight and implied an alternative method for comparing masses.

In his work on impact and still more on the centre of oscillation Huygens made great use of a fundamental principle (which he supposed to be self-evident) that the centre of gravity of a number of masses cannot ascend of itself through any motion of the masses under gravity. It followed that separate masses might have their centres of gravity brought to the height of the common centre of gravity "without the expenditure of any other force besides that which resides in the system"[1]. The principle also gave him a direct proof of Jordanus's theorem on the inclined plane. In his derivation of the formula for the distance of the centre of oscillation of a compound pendulum from the axis of rotation, Huygens combined this principle with Galilei's relation that the velocity acquired in descent under gravity varies as the square root of the height. The speeds of suspended particles at any point in the path were then deduced from the corresponding heights of descent, a procedure which really amounts, in combination with the conservation of *vis viva*, to the application of the law of conservation of energy in mechanics. Huygens had the formulæ but not the term. (Indeed if he had developed his ideas more fully the energy concept would have played an important part in physics much earlier than it did.) As for the rest of his work on suspended bodies of all forms, the derivation of the general formula is a masterly example of the inductive method and one which it is difficult to parallel. Parts of the problem could not be unravelled with the resources of classical geometry alone, and an astounding method of summation of elements had to be employed in obtaining the moments of inertia of certain solids of revolution.

Later in life, Huygens corresponded with Liebniz on the subject of the differential calculus and he collaborated with Fatio de Duillier on the new method. It came too late, however, to be of great help to him. His work illustrates almost tragically the need of the new weapon and the new notation. It is the same when we read his great work on the tautochrone, a curve which he discovered partly through practical experiments to correct the error of the clock pendulum and partly through an interest in the cycloid aroused by Pascal's 'Dettonville' problems.

Curiously enough, Huygens' study of centrifugal force also originated from his attempts to solve the practical problems of time measurement. The conical pendulum appeared to him at one time to offer certain advantages over the simple pendulum, and his first conical pendulum clock was probably constructed empirically. Huygens, of course, could not resist the temptation to investigate the laws of the new pendulum, and the theorems of the (posthumous) "De Vi Centrifuga" were the result. The statement of the theorems without proof was given at the end of the "Horologium Oscillatorium" of 1673. The importance of these for Newton's work is well known. After

reading the book, Newton spoke of his "great satisfaction" with it, "finding it full of very subtile and usefull speculations very worthy of ye Author". It is interesting to note that Newton admired Huygens' classical mathematical style and considered him "the most elegant writer of modern times".

Huygens followed the traditional view, due first to Aristotle and found in Galilei, that rectilinear and circular motions were the fundamental forms of motion. Huygens was clear that uniform rectilinear motion had no effect on events which normally occur in an apparently stationary environment. This was the foundation of his 'relativity' principle mentioned above. Circular motion, however, was not of this kind but introduced new effects. It was only after the appearance of Newton's "Principia" that Huygens retracted this statement of the absolute nature of circular motion. He then (more consistently) took a firm stand on the relative nature of all motion and against the idea of any 'absolute' space. As for the conception of a gravitational force, innate and inherent in matter, this, he wrote, "appears to me absurd" and a conception which "takes us very far from the principles of Mathematics or Mechanics".

We have here Huygens' last dependence on the mind of Descartes. Whilst he rejected the latter's dictum that the essence of matter is extension—pointing out that hardness, for example, could not be deduced from extension—he remained a Cartesian in his belief in a pervading subtle matter. This subtle matter served as a medium for the propagation of light, and its rotation in vortices around each of the planets produced the effect of gravitation. Huygens considered he had experimental evidence both of the existence of the subtle matter and of the way in which its circular motion could produce a centripetal force. He found that mercury, in certain circumstances, would not descend from an inverted tube mounted in the manner of a barometer and placed in the receiver of an air pump. He failed to note the need of a film of moisture for this phenomenon, which is now ascribed to the tensile strength of the liquid, and instead supposed that a medium other than air supported the mercury column. Huygens did not proceed from this subtle matter to embrace the entire vortex theory of Descartes. On the contrary, he saw that these vortices "are superfluous [in astronomy] if one admits the system of Mr. Newton where the movement of the planets is explained by the gravity towards the Sun and the *vis centrifuga* which balances it. . . ." Nevertheless, he himself rather illogically retained a limited vortex theory because he considered it essential to explain gravitation and because he needed the pervading medium in his wave theory of light. It may be mentioned that, for him as for Descartes, light was more than a mere phenomenon for laboratory study ; it was something cosmic, something belonging to the stars. One of Descartes' treatises was in fact called "Le Monde ou Traité de la Lumière". But when all is said, it is remarkable if Huygens did not perceive how completely Newton's "Principia" had shattered the Cartesian vortices.

There is little space in which to refer to Huygens' voluminous work in optics. In his laboured geometrical notation he introduced several important formulæ into optics, notably for refraction at convex and concave spherical surfaces, the position of the image formed by a thin lens and the magnification produced both by a single lens and by a telescope. He did much to improve the telescope by estimating the amount of spherical aberration of objectives and the optimum conditions for reducing this effect, and also by constant experiment on methods of grinding and polishing lenses. Through his labours astronomers gave up the quest for lenses of other than spherical form which had been started by Descartes. In his scornful way, Leibniz once remarked : "The best *apologia* that could be made for M. Descartes would be to complete his hyperbolic spectacles, which are the only useful things he discovered—if it were practicable to do so . . ." Huygens in fact showed that even this game was not worth the candle.

The main ideas of Huygens' "Traité de la Lumière" in which he expounded his wave theory of light are sufficiently well known. The most important points of superiority over other wave theories of the time were the idea of secondary wavelets generating a wave front, and the exact geometrical construction for the reflected and refracted rays. Huygens' attempt to explain double refraction by utilizing spheroidal wavelets as well as spherical ones and his relating of the spheroidal surface with the fine structure of the crystal are also brilliant exploits. The curious question of why back-waves are not observed was not overlooked by Huygens. But as the longitudinal vibrations were supposed to be transmitted through hard particles in contact and in accordance with his laws of percussion, Huygens considered a back-wave could only be set up if some particles smaller than the rest were present, for then only would there be a rebound of a particle after impact. When the particles are all equal the compressional pulse was transmitted without displacements occurring.

Huygens was inclined to be dogmatic and intolerant of ideas which were repugnant to him. Both over Fermat's least time principle—"this pitiable axiom"—and over Newton's work on the composition of white light, he had to alter his

opinions. He was convinced that colour was a matter which was beyond mathematical treatment and his reception of Newton's early paper was very disappointing. Until the essential explanation of colour was reached, he wrote, "he [Newton] will not have taught us what the nature and difference of colours consists of, but only this accident (which assuredly is very considerable) of their different refrangibility". Huygens' attitude here recalls his criticism that Newton should have explained the cause of gravitation. These were the evil influences of the Cartesianism which he never wholly eradicated. For even whilst he perceived Descartes' faults more clearly than any of his critics, the outlook and the vision of the great philosopher had been too great a part of his early training to be utterly rejected. Huygens was in these respects a Cartesian in spite of himself. Mouy[2] has gone further than this and has contended that Huygens' work in effect instituted a mathematical Cartesianism, and that through Huygens Cartesianism did really enter modern science. Against this we have Huygens' own words, written late in life, that he could find "hardly anything" he could accept "in all the physics, metaphysics or meteors" of Descartes.

Huygens was in fact a modern. He showed scant respect for systems whether philosophical or religious, and accordingly had several clashes with the Jesuits and the doctrinaire Cartesians. Kircher, who adopted the cosmology of Tycho Brahe, he openly criticized for his timidity. We others, he asserted, are "without fear". It is thus not surprising that Huygens saw that Descartes, for all his brilliance, had really repeated the errors of scholasticism, for he had hoped to found a demonstrative and deductive science. More than any other man of science, certainly more than Leibniz, Huygens uncovered the errors of the great Cartesian mechanism. To him is due the fact that Cartesianism never became more than a provocative and stimulating vision of the realm of Nature.

[1] "Horologium Oscillatorium", Part 4, Hypothesis 1.

[2] Mouy, P., "Le Développement de la Physique Cartésienne 1646–1712" (1934).

OBITUARIES

Prof. C. G. Seligman, F.R.S.

BY the death of Prof. C. G. Seligman, emeritus professor of ethnology in the University of London, which took place at Oxford on September 19, anthropological studies in Great Britain have lost the support and inspiration of one who had been an outstanding personality as investigator in the field and as teacher for the greater part of the present century. As is shown by the record of his earlier years, he might well have attained eminence in more than one of the medical and kindred branches of scientific study; but his association with the late Dr. A. C. Haddon on the Cambridge Anthropological Expedition to the Torres Straits in 1897 inspired him with an interest in ethnology which ultimately led him to make the study of early man and the life of primitive peoples from every side and in the broadest sense the major object of his life work. Yet final judgment upon his standing in the world of science cannot fail to take into account that his acute and versatile mind was quick to seize upon the essentials of any new or suggestive lines of investigation in other branches of study, which might bear upon his own subject, such as, for example, recent developments in psychology and the interpretation of dreams, not only turning it to his own purpose, but more often than not also making some original constructive contribution of his own to its advancement.

Charles Gabriel Seligman was born in 1872 and educated at St. Paul's School, and St. Thomas's Hospital, London, where he became house-physician, studied pathology with a Salter research fellowship, and held the appointment of director of the Clinical Research Laboratory. In the meantime, as already mentioned, he visited Queensland, New Guinea and Borneo as a member of the Cambridge Expedition to the Torres Straits, studying native diseases, childbirth customs and other native practices, ceremonies and beliefs. On his return to England in 1899, while still holding his appointment in the Clinical Laboratory, he was preparing himself for further work in the anthropological field. This took shape in the Cooke-Daniels expedition to New Guinea in 1904, of which he was joint leader with Major Cooke-Daniels. Seligman's scientific observations on this expedition were embodied in "The Melanesians of British New Guinea" (1910), a work which set a new standard in detailed observation of a primitive people as well as in the analytical study of ethnological problems on a first-hand knowledge acquired in the field. On his return from this expedition, Seligman once more took up medical studies for a time. In 1906 he was awarded the gold medal in pathology at the London M.D. examination and delivered the Hunterian and the Arris and Gale Lectures.

Hence onward Seligman's interests centred in anthropology. To this his marriage to Brenda Z. Salaman contributed in no small degree. It in no way detracts from Seligman's qualities or achievements to say that his outstanding position as an anthropologist was in no small measure due to Mrs. Seligman's devotion, encouragement and collaboration. Their first joint enterprise was an expedition in 1908, under

Government auspices, to the Veddas of Ceylon, where much valuable work of observation was done. Their material was embodied in "The Veddas" (1911), a standard work of which they were jointly the authors. Mrs. Seligman's work on this expedition was complementary to that of her husband, for in their association Seligman was giving practical effect for the first time to a plea which Dr. Haddon had long urged for the inclusion of women observers for obvious reasons in ethnographical expeditions among primitive peoples.

This association was continued when from 1909 onward Seligman became interested in Africa, and was engaged for some years under Government auspices in the study of the peoples of the Sudan, not only collecting the information which was embodied in "The Pagan Tribes of the Nilotic Sudan" (1932), but also laying the foundations of what is now the most efficient native survey service under British administration. Of the scientific importance of Seligman's discoveries among the Nilotic tribes in relation to the history of the kingship all readers of later editions of Frazer's "Golden Bough", as well as of his own Frazer Lecture, "Egypt and Negro Africa, a study in the Divine Kingship" (1934), are well aware. Another outcome of Seligman's African studies was an excellent little volume "The Races of Africa" in the "Home University Library".

Seligman was possessed of a highly developed artistic sense, which his scientific interests had fostered rather than blunted. It led him to the study of Chinese art and antiquities. He formed a small but choice collection, for which he built a museum at his home at Toot Baldon, and made his last journey of any considerable extent when in his later years he visited China to obtain a first-hand view of Chinese culture.

In 1910 Seligman was appointed lecturer in ethnology in the University of London and in 1918 he became professor in that subject, being attached to the London School of Economics, where he was associated with Prof. B. Malinowski. He retired in 1933, being granted the title of professor emeritus. The value of his work was widely recognized. In 1915, he was president of Section H (Anthropology) of the British Association; in 1918 he was admitted to fellowship of the Royal Society; and he was president of the Royal Anthropological Institute during 1923–25. He was awarded both the Rivers Memorial Medal for work in the field (1925) and the Huxley Memorial Medal (1932) of the Royal Anthropological Institute, as well as the Annandale Memorial Medal of the Royal Asiatic Society of Bengal (1931).

The late C. G. Seligman and I were very old friends. We were born in the same year and met first at about the age of sixteen at the house of the late F. M. Halford, the greatest authority of his day on dry-fly fishing. We were both beginning to be interested in biology, and Halford was an enthusiast in microscopy, possessing a powerful binocular instrument with the then new oil-immersion lenses. We used to visit him on most Sunday afternoons; another of his young visitors being the late Edwin Montagu, afterwards Secretary of State for India and a successful promoter of sanctuaries for rare birds.

Seligman proceeded from school to St. Thomas's Hospital, I to Cambridge. But we spent two summer holidays during these undergraduate years together, one on a walking tour in the New Forest, the other on a visit to Norway. Even in these early days his outstanding characteristics were his absorbing love for biological research, his power of concentration and his independence. His possession of independence was scarcely surprising, as he had lost both parents at an early age and was brought up in the homes of strangers.

Thus it was that in 1897, when the late A. C. Haddon was considering the personnel of his memorable expedition from Cambridge to the islands of the Torres Straits, New Guinea and Borneo, I (his old pupil) brought the two together, and Seligman accepted his offer to join it. Under the guidance of Haddon and Rivers, Seligman learnt his anthropology. At first he made a speciality of investigating native diseases and native treatment, collecting medicinal and other plants and information about the customs and rites of women during parturition and at puberty. But later his work during the expedition covered almost the whole field of anthropology.

While Rivers, McDougall and I were carrying out mainly psychological investigations in Murray Island, Seligman was for most of the time in New Guinea. While there, so keen became his interest in ethnology that he seriously considered the offer which he received of medical practice at Port Moresby.

The expedition decided Seligman's career in ethnology as it did mine in psychology. I have already mentioned his whole-hearted devotion to science, his perseverance and his thoroughness. His bravery in the face of continuous ill-health during later life is also noteworthy. To these qualities he added the wider social ones of blunt honesty and of unfailing loyalty to his friends. C. S. Myers.

In a message received from Sir James Frazer, he asks us to say he esteemed very highly Dr. Seligman's contribution to the science of man; he regrets that the state of his eyesight prevents him from making a fuller acknowledgment of the debt which he owed.

Prof. L. O. M. von Rohr

The announcement of the death of Prof. Louis Otto Moritz von Rohr will be greatly regretted by his many scientific friends in Great Britain.

Prof. von Rohr was born at Lazyn, Kreis Hohensalza, Germany, on April 4, 1868, and had therefore reached the age of seventy-two.

At the University of Halle he was a student under the late Prof. G. Contor and obtained there the degree of Ph.D. in 1892. A few years thereafter at the age of twenty-seven he commenced his life-long association with the firm of Carl Zeiss as technical collaborator under the arrangement introduced by the late Prof.

Abbe whereby young men of ability, while holding academic appointments, were engaged by Messrs. Zeiss, to the advantage of the collaborator and of the firm. They were afforded the opportunity, so often lacking elsewhere, of communicating direct to the firm the results of special research and of participating in the work of development, and in so doing of acquiring technical experience of the most advanced nature. Dr. Moritz von Rohr undoubtedly appreciated the importance of such a connexion and made the fullest use of his opportunities.

In 1913 von Rohr received the additional appointment of assistant professor in the Department of Medical Optics at the University of Jena. His interests were soon diverted to the field of optics and particularly ophthalmics; but although he might have made a name for himself in the more creative field of research, he became at an early stage of his career greatly interested in the history of the science to which he had become devoted. Even in his earliest contributions the historical aspects of the subject tend to predominate over the more technical details.

Von Rohr soon became by far the most important writer in every branch of historical optics. Although his knowledge of previous writings was profound, much of his material was the result of personal research. To ensure the accuracy of the information, he travelled widely and was unsparing of his strength. Few writers on any one subject can ever have been the author of so many contributions. The list is of extraordinary length. Dr. von Rohr will be remembered not so much because of any outstanding original creative work, but rather as a historian who discovered and recorded much valuable material that otherwise would have been lost to the scientific world. JAMES WEIR FRENCH.

Prof. Hans Zinsser

THE recent death in New York of Prof. Hans Zinsser, when he had nearly completed his sixty-second year, has removed an outstanding personality from the ranks of American bacteriologists. His work in the field of immunology and his researches during the past ten years into the prevention of typhus fever by means of a vaccine prepared from the causal organism had secured for him a world-wide reputation. Moreover, numerous interests, which extended far beyond the sphere of his scientific work, engaged his leisure hours, and thus he gave the impression of having lived intensely, even during the prolonged illness of which he clearly foresaw the inexorable end.

Zinsser was professor of bacteriology at Stanford University, California, from 1911 until 1913; at Columbia University, New York, from 1913 until 1923; and afterwards at Harvard Medical School, Boston. He was a member of the American Red Cross Sanitary Commission to Serbia in 1915; and in 1917 he served in the Medical Corps of the U.S. Army in France, where he acted as assistant director of the laboratories. In the summer of 1923 he visited Russia as sanitary commissioner for the Health Section of the League of Nations.

Problems investigated by Zinsser and his co-workers include: the mechanism of bacterial allergy; the immunological significance of certain non-protein substances extracted from the tubercle bacillus and other bacterial species, a series of observations which were later illuminated by Avery and Heidelberger as a result of their pioneer work on the type-specific polysaccharides of the pneumococci; the essential identity of the various manifestations of the antibody reaction; a comparison of the precipitation and agglutination reactions as influenced by the surface, in the aggregate, of the antigenic particles exposed to the action of the antibody component; and—in a different category—studies on the causative virus of Brill's disease, of herpes and of typhus fever.

Zinsser was the author of a lucid, exceptionally well-written and deservedly popular text-book of immunology under the title "Resistance to Infectious Diseases"; he prepared the latest edition with the aid of his colleagues Enders and Fothergill. His book "Rats, Lice and History", a popular account of the history and mode of transmission of typhus fever, won the good opinion of readers on both sides of the Atlantic not only by its solid background of knowledge but also by the numerous divagations from the main theme into the by-ways of literature and philosophy with which the reader is beguiled. He has also written an objective account of his life and experiences, which was recently published in the United States and has been acclaimed to be of unusual merit. We understand that the book will appear shortly in Great Britain, and we cannot doubt but that the self-portrait it contains will reveal the character of one whose interests ranged widely throughout the domains of thought and action and who, when his health finally broke down, met his fate with calm and even light-hearted courage. Perhaps, after all, it was for the best that a man of his intellectual energy should have been spared the "cruel disintegration of slow years", the tragedy of old age to which he thus alludes in the last sonnet he wrote. G. F. PETRIE.

WE regret to announce the following deaths:

Dr. William Bowie, president during 1933–36 of the International Union of Geodesy and Geophysics, on August 28, aged sixty-eight.

Prof. R. S. Dugan, professor of astronomy in Princeton University, on August 31, aged sixty-two.

Sir Henry Head, F.R.S., the eminent neurologist, former editor of *Brain*, on October 8, aged seventy-nine.

Prof. E. H. Lindley, professor of psychology in the University of Kansas during 1898–1917, on August 21, aged seventy-one.

Prof. H. H. Nicholson, professor of chemistry in the University of Nebraska during 1882–1905, on August 17, aged ninety-five.

Prof. Vito Volterra, For. Mem. R. S., formerly president of the International Committee of Weights and Measures, aged eighty.

NEWS AND VIEWS

The War and the British Fauna

It is probably still too early to judge the effects of the War upon British wild life, for it was not until the second or third years of the War of 1914–18, when the calling-up of older men had more extensively depleted the gamekeeping profession, that the great increase in so-called 'vermin', including rarer species like the wild cat and polecat, became of national concern; nevertheless, the present War has speeded up a great deal of this disturbance of wild life by the greater activity at home. The most noticeable effects have been an extension of the range of normally persecuted species like the carrion-crow, fox, otter, kestrel, little owl and sparrowhawk, and this may be followed by a slower extension of species like the badger and raven. The use of sand-dunes and lonely islands in the coastal defences and of rural parks for training the army has considerably disturbed the nesting haunts or 'sanctuaries' of uncommon species, particularly birds, more so than the building of factories in rural areas, and this may have a permanent effect in further reducing the nesting population of terns, waterfowl and waders.

On the other hand, the breaking up of estates and game preservation is furthering the extension of the little owl and the grey squirrel in the north of England. As in 1914–18, the rumour has gained popularity that warfare on the Continent has sent rarer Continental birds to nest in England, notably the avocet in Essex, but it is unlikely that the campaign abroad had any effect upon the British avi-fauna. Pollution of rivers has again arisen, notably on the Severn, Bristol Avon, and the Derbyshire Derwent, with considerable loss of fish life. It yet remains to be seen if the rosebay willow-herb will emulate the story of the London rocket in spreading over ruined buildings in London and other cities; that the poppy will recolonize the Flanders area in its former abundance is very likely, for the destruction of buildings has again made the soil highly calcareous.

Civic Development under War Conditions

A leading article in *Engineering* of September 27 shows that if no effective means be found to ensure the abolition of warfare the motives which have influenced the location of communities in certain districts of the earth's surface will be much the same in the future as in past history. Food and water, a dwelling-place of some kind and a reasonable measure of security against weather and the assault of enemies, these things are desired by the human race and by beasts and birds and even insects. Applied science has facilitated the establishment of communities in places where otherwise life could be maintained—if at all—with the greatest difficulty. On September 13 was celebrated the fiftieth anniversary of the foundation of Southern Rhodesia by the pioneer column which had trekked from Kimberley to take over and develop the territory for which mining concessions had been granted to Cecil Rhodes by Lobengula, the Matabele chieftain. On September 29, as related by Mr. W. J. Jarvis, city engineer of Salisbury, in a paper published in this number of *Engineering*, a beginning was made in the construction of the waterworks. The intervening fortnight had been occupied with the building of a fort which the pioneers had completed on the previous day. It is significant of the unchanging essentials of colonization that the assurance of a proper water supply was regarded as a necessary preliminary to all other activities, even though the fort was erected in close proximity to a river. It was only on the following day, September 30, 1890, that mining law was provisionally proclaimed, and prospective licences were issued to enable the provisional members of the column to proceed about the business which had brought them into what is now Southern Rhodesia.

This is a good example of the processes which have led to the establishment in their present situations of so many capital cities, the origins of which go far back into the history of mankind. It was not chance that located London and Paris and Rome and the many industrial cities like Newcastle and Sheffield in their present situations. In many cases the main considerations were the military ones which governed communal life until the general spread of a more ordered existence. Prior to 1914 this state had remained for so long in Great Britain that people had begun to regard it as settled and immutable, in spite of the wars that had periodically afflicted other European nations. The four years of war from 1914 to 1918, while they may have shaken this belief to some extent at the time, did not eradicate it. In fact the conviction that a war of such a prolonged and costly character could not be quickly followed by another seems to have encouraged both civil and industrial expansion in directions which it could scarcely have taken if the lessons of history had been properly assimilated. The experiences that Europe in general has undergone in the last twelve months suggest that the military considerations which have gradually lapsed into the background should once again be given due weight in planning for future mass movements of populations.

Heating Private Air Raid Shelters

The efficient heating and lighting of air raid shelters is a problem of interest to many at the present time. A solution suggested by Mr. D. Bellamy, the general manager of the Hull Electricity Undertaking, has much to recommend it. He has prepared a scheme extending the existing assisted wiring scheme so as to include lighting and power plug points in domestic shelters free to the consumer. The offer is to install one lighting and one five-ampere plug socket for a charge of 1*s*. per week for 18 months;

alternatively the provision of a 'warden' fire in addition to one lighting point and one 5-amp. plug socket for 1*s*. 3*d*. per week for 18 months. These proposals have been unanimously approved by the Electricity Committee, and will be put into operation as soon as the necessary approval has been obtained to the financing of the scheme. After the scheme has been approved by the Electricity Commissioners it is hoped that it will be put into operation. It is to be hoped that similar facilities will be made widespread by other undertakings throughout the country. Winter is immediately ahead, with much illness to come if the shelter-comfort problem is not dealt with promptly.

Air Raid Precautions for Users of Ammonia

The Ministry of Home Security has recently issued a pamphlet on "Air-Raid Precautions to be taken by Users of Ammonia" (London: H.M. Stationery Office. 1*d*.). The extensive use which is now being made of anhydrous ammonia refrigerating plants makes the question an urgent one. The main precaution recommended is to keep stocks of anhydrous ammonia down to the absolute minimum. If the capacity of a given plant is sufficient to provide a reservoir, no reserve stocks at all should be kept. Where it is essential to keep additional supplies in cylinders, these should preferably be dispersed to protected positions in the open away from risk of fire and stored horizontally. If such a dispersal is impracticable, the cylinders should be placed in an angle of the walls of the building and suitably protected on the exposed sides. Precautions against the escape of ammonia from the refrigerating plant include the provision of sills around the area over which liquid ammonia may flow from a broken condenser coil; and it is suggested that the condenser water should be kept running, as ammonia is readily soluble in water and the aqueous solution is less dangerous than the anhydrous liquid. In an emergency, the charge in the machine should be isolated by closing all possible stop valves. To facilitate this operation by possibly inexperienced personnel, the engine-room master-valves may be painted in striking colours. It is pointed out that cylinders to be emptied should be laid horizontally, so as to discharge the ammonia in liquid form, due care being taken to avoid burns by the splashing of the liquid.

Electric Power Stations Underground

As we see things at present, unless war can be banished from the earth we may have to revise our ideas completely as to underground power plant and underground shelters. The only really safe refuge in a great city assaulted from the air is a chamber far below the surface such as we find along some of the lowest tunnelling of the electric tubes, a level well below the maximum depth excavated by the comparatively feeble bomb of 1940. In the *Electrical Times* of September 26 it is stated that soon after the War of 1914–18 a few eminent consultants and power plant engineers sent the editor outline ideas of generating stations placed underground at low level. One of the difficulties which appeared insurmountable at that time was the supply of cooling water in large bulk at these depths. The inlet of water is easy enough, but what of the outlet? The case is a little less puzzling in that of oil-driven prime movers, but even these would strain the engineer's resources and ingenuity.

When the struggle at present raging reaches a settlement, inquiry may well be reopened. Excavations to a considerable depth and on a large scale may become essential, if only for providing an absolutely safe refuge for distracted people and hospital patients and staffs. Underground stations, too, are being used as air raid shelters. This is one stage of a difficulty which in time might become formidable; it will have to be considered along with the other problem of finding a safe lodging for the much-discussed electric power house.

British Rheologists' Club

Since the outbreak of War, new and urgent problems concerning the flow and deformation properties of materials (rheology) have arisen in many industries and in research, and a group of British rheologists have therefore formed a club for mutual help and discussion. Prof. G. I. Taylor, Yarrow research professor of the Royal Society, has accepted the presidency. The objects of the new Club are "to co-ordinate the activities of Rheologists in Britain during the War, to further the appreciation of the importance of rheology in industry and to facilitate the pooling of information (where it is desirable) with respect to problems and new methods of research". Membership of the Club is open to any individual working or interested in rheology who is resident anywhere in the British Empire, and there is a nominal subscription of five shillings per annum. Arrangements are in preparation for an inaugural meeting of the Club to be held at the National Institute for Research in Dairying, University of Reading, on November 16, when it is proposed to hold an informal discussion on a topic to be selected, followed by an inspection of rheological apparatus including some recent developments. Fuller details of the Club may be obtained from the honorary secretary, Dr. G. W. Scott Blair, c/o Institute of Physics, at the University, Reading, Berks.

Primitive Art: Past and Future

The anthropologist, when confronted with some of the more extreme pronouncements of æsthetic judgment on the primitive artist, was at one time perhaps a little too apt to regard them as unwarranted apotheoses of what was after all a phase and no more in a process of æsthetic development or 'evolution', differing in this relation in no essential from any other cultural element depending upon technical achievement. He was, however, so far justified in that each example of the artist's skill and taste was to be regarded with reference to its social and religious background; and while it might, and very often did, afford satisfaction to a judgment habituated to European canons, to award it the highest mark as

an expression of æsthetic principles, as, for example, in the better-known specimens of West African sculpture, seemed to attach a false value to characters which were, in historical perspective, faults of technique rather than an outcome, conscious or unconscious, of any theory of artistic balance, selection or composition. A saner method of approach to the products of primitive art was illustrated by Dr. Leonard Adam in a recent lecture delivered before the Royal Society of Arts (*J. Roy. Soc. Arts*, June 28, 1940) in which he briefly directed attention to certain of the main principles of primitive art which emerge from its study in accordance with the evolutionary or cultural methods elaborated by the late Dr. A. C. Haddon, Prof. Franz Boas and others. Incidentally Dr. Adam stressed the interest and importance of the art of the American Indians of the north-west coast of America, which has suffered neglect in favour of the culturally less illuminating art of Africa.

The future of primitive art is, when properly understood, no less interesting than its past. It is true that in many parts of the world European impact has brought about degeneration; but experience in West Africa has shown that this is not inevitable. It was pointed out by Dr. Adam that modern ethnographical studies have demonstrated that early observers tended to overstress the static element in primitive culture. Art, however, like other cultural factors, has been subjected to a continuous process of change. Much of the so-called primitive art is in fact both highly sophisticated and 'evolved'. The result of such European guidance in West African education as has been formulated with understanding of native modes of thought has been to produce a native school of art, which not only in the traditional art of wood-carving, but also in other branches of artistic activity such as painting, is thoroughly African in conception, feeling, and atmosphere. It has survived or overcome the break with the social and religious factors upon which African art depended, but which vanished, or are vanishing, before European contacts. Hence, as Dr. Hanns Vischer pointed out from the chair on this occasion, this development indicates a line of advance in the present deplorable state of education in Africa—a beginning "to make grow . . . to liberate something which has been stifled under the thick crust of foreign knowledge acquired without real understanding".

Rufford Village Museum

Rufford Village Museum, which was opened at Rufford Old Hall, a National Trust property in West Lancashire in July of last year as: "A Museum of Folk Culture and Industry: To illustrate and capture the spirit of the countryside" (to quote its constitution) is being developed by the honorary curator, Mr. Philip Ashcroft, jun., to be "an example for other districts to follow, so that in the future, each village or group of villages will have a museum to represent their life, history and culture". In addition to Baron Hesketh's extensive collection of old armoury and other relics of medieval life, Mr. Eric Hardy has drawn up lists of the local fauna and flora which will be exhibited above photographs, drawings, diagrams, etc., of wild life to encourage people to preserve as well as observe the wild life of the parish. This happens to be unusually rich, for the flora includes flowering rush, flowering fern, arrowhead, yellow waterlily, water soldier, bladderwort and nearly a thousand other plants; there is a list of twenty-two mammals for the parish and F. A. H. Hall and E. Hardy have drawn up a list of 101 bird records, including sixty nesting species—a third of the British records. The Museum itself is a historic old timbered hall, the restored part of which dates from the seventeenth century.

Research in Social Relations in Industry

Mr. H. Valder, of Hamilton, New Zealand, has endowed for five years a research fellowship in social relations in industry at Victoria University College, Wellington, N.Z. Mr. Valder has himself done original work in investigating problems of industry, more especially those concerning the relation of capital and labour, and he believes that the work can be carried further by a man with scientific knowledge. To ensure that the investigator may be independent, the work is to be done under the ægis of the Victoria University College Council, and the appointment will carry with it the privileges of a professorial chair in the College. The salary offered is £1,000 a year (N.Z. currency) for five years. Applications from candidates should be sent to the Registrar of the College.

Forestry Investigations in India

The activities of the Forest Research Institute at Dehra Dun, India, are summarized in a report entitled "Forest Research in India and Burma, Part 1, 1938–39". The work of the various branches of the Institute is described and the report forms a record of a large amount of useful work carried out in the interests of the State. Apart from research work, an enormous number of queries relating to the utilization of various forest products has kept the staff extremely busy during the year. It is noteworthy that all the provinces of India now employ an officer solely dealing with sylvicultural problems. The co-ordination of this work and advising on statistical requirements, in order to make the best use of the researches going on, have taxed the Sylvicultural Branch of the Institute severely.

It is not possible to make more than passing reference to a few of the programmes of work that are being carried out. The destruction of timbers by termites and by fungi is one of great importance, and this work is closely linked with problems of the seasoning and preservation of woods of many kinds. The paper-pulp section is another activity of great importance and promise, and questions connected with the manufacture of paper and plywood were probably the most numerous of all. The report itself, it may be added, is printed on paper made at the Institute from *Saccharum arundinaceum*. The cultivation of drugs is another aspect of work that

presents many problems of interest. The exploration of the potentialities of Derris as an insecticide is very encouraging, while proof that the alkaloid ephedrine, present in Indian species of Ephedra, is in no way inferior to the Chinese product as a potent remedy for asthma, opens up possibilities for India in this connexion. It is hoped that failure in the past to attend to certain essentials regarding the collection of the plants will be remedied and full advantage taken of the present opportunity for developing trade in Indian Ephedra. Among other subjects spike disease of sandalwood is still under investigation, but proof is needed that Jassidæ (leaf-hoppers) are the vectors concerned with the transmission of this baffling kind of disease.

Scottish Society for Research in Plant Breeding

THE report for 1940 of the director of the Plant Breeding Station at Craig's House, Edinburgh, includes several important practical results of scientific research. It is shown that the renovation of semi-derelict pastures is best performed by ploughing up and re-sowing. A nurse crop of Sandy oats to be grazed in July, and a mixture of varieties of one grass species, together with wild white clover, are found to be preferable to sowing a mixture of grass species under rape or a seeding nurse crop of oats.

The Ainville sub-station, used for trials, has been transferred to six acres of land, six hundred feet above sea-level, at Boghall. The breeding of potatoes resistant to blight and to virus disease is meeting with considerable success, and several selections are being further tested. It is now possible to investigate the genetical background of resistance to pure strains of the *B*, *C* and *X* viruses. The available evidence indicates an autotetraploid segregation with dominance for susceptibility. Resistance to finger and toe disease in swedes is being tested both among new seedlings and in the field. Beans, wheat, barley and kale are among the other crops which are being bred for practical purposes under the guidance of scientific principles.

Institute of Organic Chemistry in Moscow

IT is announced by "Russia Today" Press Service that work has been commenced in Moscow on the new building for the Institute of Organic Chemistry of the Academy of Sciences of the U.S.S.R. The building will consist of three blocks, the main one of which (the laboratory block) will house the seven departments engaged in the study of the different branches of organic chemistry. This block will have a volume of 1,907,000 cubic feet. In addition, there will be an autoclave building and a block for big installations and workshops, with an aggregate volume of 388,500 cubic feet. Spacious accommodation has been set aside for a library of 70,000 volumes, as well as a big reading-room and an auditorium for 250 persons. The cost of the new building, not counting special equipment, is estimated to be $12\frac{1}{2}$ million roubles. It is hoped to complete it in 1942.

Military Training for University Students

SINCE it is recognized that young men of eighteen and onwards at universities cannot undertake home defence duties without undue interference with their studies, it has been decided to expand the contingents of Training Corps at universities so that every student may enrol to obtain basic military training. Those who wish to serve in the Royal Air Force will have an opportunity of joining a university air squadron. By these means university education will be maintained, and undergraduates will be enabled to acquire useful experience.

Postponement of Nobel Awards

ON October 11 the Board of the Nobel Foundation asked the Swedish Government to allow a postponement in conferring the Nobel Prizes of 1940 for literature, physics, and chemistry until the 1941 prizes are conferred. The Medicine Prize was yesterday reserved until 1941 by the Faculty of the Carolean Medico-Surgical Institute in Stockholm.

Announcements

THE seventeenth award of the Duddell Medal of the Physical Society to Prof. E. O. Lawrence, of the University of California, which was announced in NATURE of June 1, p. 852, has a significance deeper than the honouring of a great American physicist's achievements in the invention and development of the cyclotron. Circumstances permitting, Lord Lothian, the British Ambassador to Washington, will present the Medal to Prof. Lawrence at Philadelphia on the evening of December 27, 1940, the occasion being that of a dinner in connexion with a three-day meeting of the American Physical Society. It is a particularly appropriate occasion, for on the same day there is to be also a meeting of the American Association for the Advancement of Science, at which Prof. Lawrence, as a retiring vice-president, will address one of the sections.

THE following appointments in the Colonial Service have recently been made: P. Adames, agricultural officer, Sierra Leone; E. S. Capstick, agricultural officer, Sierra Leone; J. H. Hinds, Agricultural officer, Gold Coast; J. A. N. Burra, assistant conservator of forests, Gold Coast; J. P. W. Logie, assistant conservator of forests, Kenya.

MORE than 100,000 books were destroyed or severely damaged in a fire following the bombing of the University College library during a recent air raid on London. Two members of the staff were killed and eight were wounded, and the memorial hall was almost demolished.

Chronica Botanica, the international plant science journal, established in Holland in 1935, is being published fortnightly in the United States (annual subscription, about the same as formerly when the journal was published as a bi-monthly, 7.50 dollars, foreign and domestic, post paid). Communications should be sent to Dr. F. Verdoorn, P.O. Box 151, Waltham, Massachusetts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Non-Lethality of the Mid Factor in *Lythrum Salicaria*

IN 1927 East[1] proposed a theory of the inheritance of style-length in tristylic *Lythrum Salicaria* which involved three factors. One of these, *S*, was epistatic to the others, and determined Short style as opposed to Mid and Long. The other two, each of which was supposed to give Mid style as opposed to Long, were lethal when homozygous and were linked. In 1932 East[2] seemed to abandon this theory in favour of a single non-lethal factor, having found for the first time a plant which, crossed with Long style, gave a large progeny nearly all Mid. In 1936, however, he explained[3] that the 1927 theory was not abandoned, but applicable in his opinion only to the special type of plant with which first Barlow and later he himself had worked.

As Barlow[4] was the pioneer in the genetics of Lythrum, it would be very strange if she had encountered a strain of plants in which the mechanism of the inheritance of style length not only presented unusual features, but also had been totally transformed by the substitution of two linked lethals for a single non-lethal factor in the determination of the Mid style-length, especially as all three factors have *ex hypothesi* no recognizable effects except on the form of flower. At the time of East's second paper[2], therefore, one of us planned a series of tests, involving no illegitimate matings, and using an open pollination technique. It was hoped in this way to avoid disturbances to the phenotype ratios, due possibly to illegitimate pollination, and it was soon found that large progenies with entirely reliable ratios could be obtained in this way.

The first step, aimed at settling the question of lethality, has now been completed. Four Short plants from seed of an open pollinated plot, grown at the Chelsea Physic Garden in 1936, were tested by open crossing with Long at Harpenden in the following year, and sufficiently large progenies were grown at Merton in 1938. The following classification was obtained:

Family	Long	Mid	Short	Total
A	123	0	135	258
B	130	0	130	260
C	141	0	127	268
D	63	64	139	266

The absence of Mid progeny out of 786 in the first three families is good evidence that stray pollen was effectively absent. The Short parent of family *D* evidently contained a single gene for Mid style-length. Two other such Short plants have since been found among eight more from open-pollinated seed tested in 1940.

The Short parent *D* was grown with a Mid daughter from the family set out above, in isolation in Dr. F. Yates's garden at Harpenden, and two progenies from the reciprocally crossed seed were grown this year at Merton. Since both parents contain the same gene for Mid style-length, the test is critical for the lethality of this gene. If it were lethal we should expect 2 Mid : 1 Long, otherwise 3 Mid : 1 Long.

The two progenies obtained have now been scored as follows:

	Long	Mid	Short	Total
Mid X Short ..	28	103	117	248
Short X Mid ..	25	78	94	197
Total ..	53	181	211	445
Expected (non-lethal)	55·62	166·88	222·50	

The parallelism and homogeneity of the reciprocal progenies afford further confirmation of the absence of stray pollen. As regards the segregation for Mid and Long, the frequencies accord well with the expectations for 3 : 1 (χ^2 less than 0·7, from one degree of freedom); but are incompatible with a 2 : 1 ratio (χ^2 greater than 12·0). It is virtually certain, therefore, that the gene tested is not lethal.

The material from these progenies will be available for testing other possibilities not considered by East. Of these perhaps the most important is that of autopolyploid inheritance of the chromosome carrying the Mid gene. If adequate numbers can be tested, we may anticipate finding, both among the Mids and the Shorts, plants which have certainly received the same gene from both parents, and may in this case parallel the behaviour of those which East regarded as containing linked duplicate lethals.

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1 East, E. M., *Genetics*, 12, 393–414 (1927).
2 East, E. M., *Genetics*, 17, 327–334 (1932).
3 East, E. M., *Amer. Nat.*, 70, 5–12 (1936).
4 Barlow, N., *J. Genet.*, 3, 53–65 (1913); 13, 133–146 (1923).

Cardiac Metabolism and Rigor in Thyroidectomized Rats

IN order to elucidate the possible influence of the thyroid on heart metabolism, the effect of thyroidectomy on the course of cardiac rigor in rats has been studied.

Rigor was followed graphically according to the method of Chang, Patras and Templeton[1]. The results obtained are summarized below and will be

published in full detail elsewhere. For the present purpose, two time units of measurement will be distinguished: (*B*) the time in minutes from the removal of the heart to the onset of rigor, and (*S*) the time in minutes from the removal of the heart until rigor is maximal.

Rats which are rendered unconscious by a blow on the head or neck yield a shock rigor curve which is far shorter than normal. It may be seen from Table 1 that treatments 3, 4, 6, 8, 9 and 10 enhance the shock effect and lead to an onset of rigor immediately after the heart beat ceases. The onset of the effect and its disappearance on recovery are reflected in the shape of the rigor curve. Digitalis or cardiazol (Table 1, treatments 5 and 7) almost completely nullify the influence of brain shock, asphyxia, or exhaustion on the rigor, but do not nullify the influence of thyreotoxic principle. Chronic asphyxia (45–120 min. exposure to an atmosphere of approximately 5·8 per cent oxygen) does not influence the rigor curve.

TABLE 1

No.	Normal		Thyroidectomized		Treatment
	B	*S*	*B*	*S*	
1	25·0	44·2	44·4	67·8	Amytal narcosis
2	10·0	22·1	42·6	59·9	Shock by blow on neck
3	4·2	14·2	47·0	62·3	0·5 mgm. strychnine + blow on neck
4	6·0	17·3	39·5	61·5	0·008–0·02 gm. caffein sodium benzoate + blow on neck
5	26·0	40·3			5–6 mgm. cardiazol + blow on neck
6	9·0	23·0	37·9	55·2	20 minutes swimming, death under amytal narcosis
7	15·4	36·4			Same treatment + previous digitalis treatment
8	5·0	13·3	17·4	35·7	KCN (6 mgm. subcutan.), death under amytal narcosis
9	1·5	5·0	2·0	8·5	0·15 mgm. mono-iodoacetate, death under amytal narcosis
10	3·8	9·0			Iodothyrine + blow on neck

The cardiac rigor curve of thyroidectomized rats is essentially different from that of normal rats (Table 1). The former is of markedly greater duration and is not influenced by brain shock, caffeine or strychnine administration. Exhaustion does not affect this curve. Digitalis is without influence upon it. Acute asphyxia causes a marked but relatively smaller curtailment of the rigor curve when thyroidectomized rats are used. Chemical rigor produced by mono-iodoacetate poisoning is, on the other hand, essentially the same in thyroidectomized as in normal rats.

The beating time of thyroidectomized rat heart immersed in Ringer solution at 36° C. is twice that of normal rat heart.

TABLE 2

Animals	No. of exp.	Heart glycogen gm. %	Loss of heart glyc. through chronic oxygen lack gm. %	Loss of heart glyc. through chron. oxygen lack in % of initial value	Muscle glycogen gm. %	Liver glycogen gm. %
Thyroidect.	15	0·250	0·113	31	0·27	1·92
Control	15	0·068	0·142	68	0·26	1·84

The markedly greater glycogen content of the heart of thyroidectomized rats is only slightly reduced by killing without narcosis through a blow on the neck (Stein, Tuerkischer, Wertheimer[2]). Chronic oxygen-lack affects the cardiac glycogen content of thyroidectomized rats to a lesser extent than it does the cardiac content of normal rats. Both treatments reduce the cardiac glycogen content of normal rat to a minimum. KCN and also caffeine have an identical effect on the heart glycogen of both thyroidectomized and normal rats. Thyroidectomy does not produce any of the above-mentioned deviations from normal in skeletal muscle.

The total creatinine content of the heart of thyroidectomized rats averages 23 per cent more than normal. Skeletal muscle of thyroidectomized rats gives normal creatinine values. Cardiac phosphagen and lactic acid content are not changed by thyroidectomy.

The specific nature of the changes produced by thyroidectomy in cardiac rigor, glycogen storage, and total creatinine content leads to the conclusion that removal of the thyroids affects the special metabolism of heart muscle in a manner which is not dependent on the depression of general metabolism by thyroidectomy.

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June 23.

[1] Chang, St., Patras, M. C., and Templeton, R. D., *Amer. J. Physiol.*, **118**, 423 (1937).
[2] Stein, L., Tuerkischer, E., and Wertheimer, E., *J. Physiol.*, **95**, 356 (1939).

Drinking Habits of Animals

IN a recent publication[1], I made reference to a paper by Gregersen[2] in which he recorded that dogs, confined in cages and fed once a day, drank water from time to time during 2–5 hours after the meal and scarcely at all at other times of the day. I interpreted this to mean that the dogs did not drink water until an interval of two hours had elapsed after the time of feeding, whereas the charts shown in Gregersen's paper indicate clearly that the dogs drank water from time to time during the 2–5 hours *immediately* following the time of feeding. I wish to record my apology for my error.

Also, mention is made, in my paper already referred to, of the drinking habits of leopards kept in confinement and fed once a day on flesh. Further observations made on one such leopard showed that, although on several occasions it did not drink water after feeding until an interval of about 2 hours had passed, this was not a constant habit. The observed intervals, expressed in minutes, between the time of completion of a meal and the time of first drinking water thereafter were: 2, 6, 15, 50, 56, 115, 120, 121, 148.

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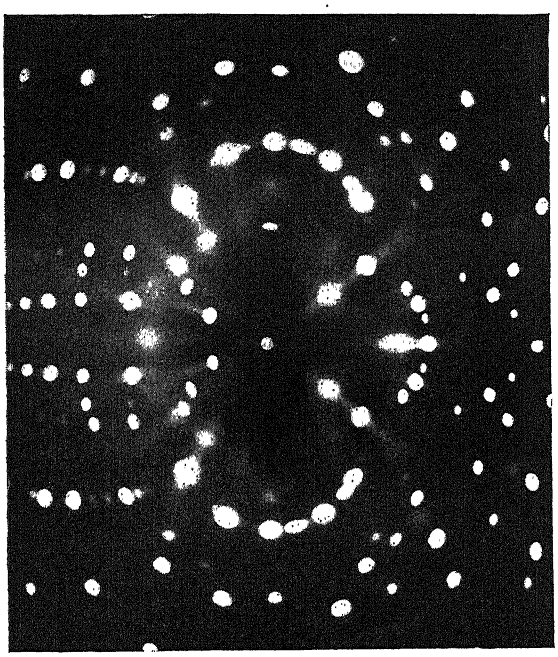
[1] Brownlee, A., *J. Comp. Path. and Ther.*, **53**, 55 (1940).
[2] Gregersen, M. I., *Amer. J. Physiol.*, **102**, 344 (1932).

Modified Reflection of X-Rays

As stated in an earlier communication[1], quantum theory leads to the remarkable conclusion that the reflection of X-rays in crystals is of two types; first, the classical or unmodified reflections associated with the normal structure amplitudes of the crystal; and secondly, the quantum or modified reflections which arise when the vibrations of the crystal lattice are quantum-mechanically excited by the incident X-radiation. The direction and intensity of the reflections of the second kind have been considered theoretically in a recent paper[2]. It is shown that when the energy taken up by the crystal lattice is in the form of *acoustic waves*, the recoil of the photon is observable as *a diffuse scattering* of the incident X-radiation, while on the other hand, when the *optical vibrations of the crystal lattice* are excited, the resulting effect is *a regular reflection* of the incident radiation.



MODIFIED REFLECTIONS WITH CALCITE.

The geometric law of quantum or modified reflection, shown to be experimentally valid by an extended series of measurements[3] with sodium nitrate and with rock-salt crystals, takes the very simple symmetric form $2d \sin \frac{1}{2}(\theta + \varphi) = n\lambda$, where d is a crystal spacing, and θ, φ are the glancing angles of incidence and reflection with respect to such spacing. The formula leads to the interesting conclusion that the angle between the incident and reflected rays is independent of the setting of the crystal though, as shown both by theory and experiment, the intensity of the reflection does depend on such setting.

TABLE I. 400 Modified Reflections observed with a Rock-Salt Crystal. $\lambda = 0{\cdot}708$ A., $d = 2{\cdot}814$ A.

θ	φ	$\theta + \varphi$	d (calculated) Symmetric formula	d (calculated) Asymmetric formula
9° 40′	19° 18′	28° 58′	2·83 A.	2·76 A.
11° 36′	17° 26′	29° 2′	2·82 ,,	2·78 ,,
17° 46′	11° 22′	29° 8′	2·82 ,,	2·85 ,,
19° 21′	9° 57′	29° 18′	2·80 ,,	2·85 ,,
25° 21′	3° 57′	29° 18′	2·80 ,,	2·89 ,,

Table 1 (fourth column) gives the spacings calculated by the stated formula from observations on the second-order modified reflections from the cleavage planes of a rock-salt crystal, and shows fair agreement with the known crystal spacing. It is given here especially to exhibit the fact that there is no such agreement between the actual crystal spacing and the values entered in the fifth column, which have been calculated from the formula:

$$d(\sin \theta + \cos \theta \tan \varphi) = n\lambda.$$

In the latter formula, φ indicates, according to Faxen[4] and to Zachariasen[5], the direction of maximum intensity in the diffuse thermal scattering of X-rays by a cubic crystal.

The well-defined character of the quantum reflections given by an ideal crystal is illustrated in the accompanying reproduction, which is a strongly exposed Laue pattern of calcite. It exhibits the modified reflections by numerous planes in the crystal including, especially, the first, second and third order reflections from the cleavage planes, the K_α and K_β spots being clearly separated.

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August 18.

[1] NATURE, 145, 860 (1940).
[2] Raman and Nath, *Proc. Ind. Acad.*, 12, 83 (1940).
[3] Raman and Nilakantan, *Proc. Ind. Acad.*, 11, 398, and 12, 141 (1940).
[4] Faxen, *Z. Phys.*, 17, 277 (1923).
[5] Zachariasen, *Phys. Rev.*, 57, 597 (1940).

Atomic Energy Values of Ionized Tellurium (Te II)

THE identification of the structure of the spectrum of singly ionized tellurium, briefly reported by one of us previously[1], has led to the following absolute values of the characteristic terms:

$5p$	${}^4S_{1\frac{1}{2}} = 173801$	$6s$	${}^2P_{1\frac{1}{2}} = 85375{\cdot}8$
	${}^2D_{1\frac{1}{2}} = 163580$	$6p$	${}^4D_{\frac{1}{2}} = 74458{\cdot}6$
	${}^2D_{2\frac{1}{2}} = 160847$		${}^4D_{1\frac{1}{2}} = 72811{\cdot}2$
	${}^2P_{\frac{1}{2}} = 152281$		${}^4D_{2\frac{1}{2}} = 66515{\cdot}4$
	${}^2P_{1\frac{1}{2}} = 148101$		${}^4P_{\frac{1}{2}} = 77008{\cdot}9$
$6s$	${}^4P_{\frac{1}{2}} = 95352{\cdot}6$		${}^4P_{1\frac{1}{2}} = 74376{\cdot}0$
	${}^4P_{1\frac{1}{2}} = 91057{\cdot}5$		${}^4P_{2\frac{1}{2}} = 70364{\cdot}6$
	${}^4P_{2\frac{1}{2}} = 87704{\cdot}4$		${}^4S_{1\frac{1}{2}} = 65461{\cdot}6$
	${}^2D_{1\frac{1}{2}} = 78944$		${}^2P_{\frac{1}{2}} = 73362{\cdot}4$
	$\alpha = 71559$		${}^2P_{1\frac{1}{2}} = 68150{\cdot}4$
	$\beta = 83810$		${}^2D_{1\frac{1}{2}} = 71733{\cdot}8$
$6s^-$	${}^2P_{\frac{1}{2}} = 89246{\cdot}1$		

The ionization potential of Te II, as determined from the largest term $5p\ {}^4S_{1\frac{1}{2}} = 173801$ cm.$^{-1}$, is 21·5 volts approximately. The detailed results will be published elsewhere.

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[1] NATURE, 143, 376 (1939).

RESEARCH ITEMS

Bony Growths in the Human Jaw

CERTAIN secondary formations on the human jaw were first reported in 1884 by Danielli. Though noted repeatedly since by various scientific workers, they are still far from being generally known and understood. Aleš Hrdlička, in a recent discussion of the condition (*Amer. J. Phys. Anthrop.*, **27**, 1 ; 1940), has reviewed and analysed recorded observations and has added to them new data based upon an examination of 5,632 lower jaws—cases which offered no possible doubt as to the nature of the formation. These hyperostoses consist of various grades and forms of supplementary hard bony tissue above the mylo-hyoid line on the lingual surface of the mandible. They have no connexion with anything pathological, though they may, when over-developed, cause trouble mechanically. They do not as a rule develop in the higher apes. In man they occur sporadically from palæolithic times—they are reported in Sinanthropus—are more frequent in the neolithic period, and later grow more or less common in various human groups. They do not show any clear racial selectiveness, but are more common in the Yellow-Browns than in White or Black. This preponderance, however, appears more regional than racial. It is most marked in the northernmost or cold, least marked in the southern or warm, regions. A remarkable and instructive difference is seen to exist between the North American and the Old Peruvian Indians ; in the latter the hyperostoses are almost wanting, while in the North Americans they are four times in number and even more in weight. The evidence furnishes a strong indication that the mandibular hyperostoses are neither of phylogenetic transmission nor show any plain racial heredity. Apparently they are brought about by environmental conditions, which can only mean food, and hence mastication. They tend to be both more frequent, and on the whole more strongly developed in the males. It is impossible to reach any conclusion other than that they are caused by stresses of mastication in excess of the capacity of the individual bones, and that they are the efforts of the organism to provide additional strengthening to the parts affected.

The English Sparrow in the United States

THE common house-sparrow, introduced from England to Brooklyn (N.Y.) in 1850 and 1852, has long been established in the United States beyond the possibility of eradication. And the introduction and establishment are regretted, for the evidence gathered by a new investigation of the activities of the bird show that its harmfulness to agriculture outbalances whatever good it does. E. R. Kalmbach in his inquiry into the economic status of the sparrow examined the food content of 8,004 stomachs, a larger number than ever before employed in the study of the food habits of a single species of bird (U.S. Dept. Agric., Tech. Bull., No. 711 ; June 1940). Since the publication fifty years ago of Barrows' classic account of the sparrow in the United States, the range of the species there has more than doubled and the bird has come to be of economic importance in every State. It is admitted that in special localities and on special occasions sparrows have done notable service, for example, in destroying the alfalfa weevil in Utah in 1911 and 1912 or in destroying bark-beetles in a lumber-yard in Alabama in 1913–1915, but such beneficial activities are almost confined to the short period when the nestlings are fed on insects. They do not appear to counterbalance the real and potential harm with which the adults must be charged on account of their feeding activities. In addition, it is known that the sparrow is an agent in the transmission of certain poultry parasites and diseases. The author, however, does not advise ruthless slaughter ; control measures should always be limited to the needs of the occasion, and it should be remembered that in cases of unforeseen insect plagues the sparrow may turn out to be a valuable helper in checking and suppressing the enemy.

Variation in the Bull- or Gopher-snakes (*Pituophis*)

IN the first thorough attempt which has been made to analyse the variations in the snakes of the genus Pituophis, Olive Griffith Stull recognizes six species and thirteen "forms" (*U.S. Nat. Mus. Bull.*, **175** ; 1940). This genus of conspicuous and well-known snakes ranges from Guatemala to Canada, including most of Mexico, all the United States west of the Mississippi, several to the east, and all Atlantic States from Alabama to New York, and everywhere it seems to be little restricted as to habitat. Comparison of the different forms in their geographical relationship shows that from the probable centre of dispersal outwards a general decrease in scale characters accompanied by an increase in proportionate length of tail occurs in all forms. Also in every form which is represented by a sufficient number of specimens there is a similar variational tendency in scale rows, ventrals, and caudals. As a rule decrease in scale characters within any form is correlated with general dwarfing, but this is not necessarily true for comparisons between different forms. Sexual variation is indicated by higher numbers of scale rows and ventrals in the females, and higher caudals, proportionate tail length and number of tail spots in the males.

X-Ray Radiation on Tradescantia Chromosomes

A. C. FABERGÉ (*J. Genetics*, **40**, 379–384 ; 1940) describes an experiment involving the radiation of chromosomes of *Tradescantia bracteata* by X-rays of differing wave-lengths. He shows that several checks on the accuracy of such an experiment may be made by statistical treatment ; it is shown that in this experiment it is uneconomical to examine more than 18 cells per slide. The estimation of chromosome breaks was made by counting the number of bodies in the cell after radiation. No difference between the results of hard and soft radiation was found.

Cyto-genetics of Brassica

THE genus Brassica contains species showing aneuploid chromosome numbers and is interesting from an evolutionary point of view. S. M. Sikka (*J. Genetics*, **40**, 441–509 ; 1940) has studied the chromosomes of several species and hybrids between them. *B. juncea* is an allopolyploid derived from the crossing of *B. campestris* and *B. nigra*. The hybrid between *B. tournefortii* and *B. trilocularis*, although

both have $2n = 20$ chromosomes, has an irregular meiosis showing a quadrivalent, 1–3 bivalents or a lack of pairing in different nuclei. On the other hand, *B. rapa* $\times$ *B. trilocularis* shows 10 bivalents at meiosis. The correlation between the number of satellites and number of nucleoli was observed, while secondary association indicates that the basic chromosome number of the genus is five. Hybridization has played the most important part in the evolution of the genus.

Physiology of Storage in Bananas

A recent publication by C. W. Wardlaw (Mem. 15, Trinidad Low Temperature Research Station, May 1940), on the storage of Gros Michel bananas, centres around the possibility of transporting fruit from Trinidad by the use of refrigerated gas storage. The problem is to retard ripening without serious disturbance in the course of metabolism. The results obtained under laboratory conditions indicate that with suitable control of atmospheric conditions, bananas considerably heavier than "3/4 full" could be safely subjected to a journey of some 16 days with no deleterious effects on the fruit when afterwards ripened. Thus, when rapidly cooled to 53° F. in an atmosphere containing 5 per cent carbon dioxide and 5–7 per cent oxygen, considerable retardation of ripening is produced, in comparison with controls in air, with no evidence of chilling or gas injury. A carefully regulated series of experiments indicate these as the optimum atmospheric conditions. It is further suggested that this atmosphere could be maintained under storage, without recourse to artificial atmospheres, by the use of 'gas-tight' holds, carefully controlled ventilation and partial removal of oxygen by chemical means, and by control of the (vol. of fruit/vol. of hold) ratio. It is emphasized that fruit showing incipient ripening must be rigidly excluded, since the presence of even small quantities of such fruit tends to accelerate the ripening of immature fruit, probably by accumulation of physiologically active substances.

Composition of Coal

The resins and hydrocarbons which exist in small proportions in coal are of considerable importance in the caking properties. In the rational analysis of coal, these resins and hydrocarbons are extracted with pyridine but it is known that this extraction is incomplete: in the residue there is still a fraction dissolved by subsequent extraction with benzene under pressure. R. Belcher and R. V. Wheeler (*J. Chem. Soc.*, 866; 1940) have examined the use of quinoline (already used by Vignon in 1914) instead of pyridine as a primary solvent but find that it has no advantage over pyridine either in rapidity or completeness of extraction. With technical quinoline exposed to daylight there is also a possibility of the photochemical formation of material liable to be confused with the true extract.

Phosphonium, Arsonium and Stibonium Salts

J. Chatt and F. G. Mann (*J. Chem. Soc.*, 1192; 1940) have shown that tetraphenylarsonium salts can be obtained by the action of aluminium chloride on (1) arsenic trichloride and benzene, (2) phenyldichloroarsine, (3) diphenylchloroarsine, (4) triphenylarsine, (5) triphenylarsine and bromobenzene, the best yield being obtained in (5). Tetraphenylphosphonium and tetraphenylstibonium compounds can be obtained by methods analogous to (5). The tetra-arylstibonium salts were hitherto unknown. The reactions evidently follow a complicated mechanism, involving the migration of phenyl radicals.

Constitution of Pectic Acid

The structure of a pectic acid or polygalacturonic acid prepared from citrus pectin by treatment with dilute hydrochloric acid has been examined by Miss S. Luckett and F. Smith (*J. Chem. Soc.*, 1106, 1114; 1940). By methylation with methyl sulphate in presence of alkali, precipitation of the thallium salt of the methylated acid, and reaction of this with methyl iodide, the methyl ester of the methylated pectic acid was obtained as a solid. Hydrolysis of this with methyl-alcoholic hydrogen chloride gave as the main product the methyl ester of 2 : 3-dimethyl galactofuranoside, the structure of which was confirmed by its oxidation to 2 : 3-dimethyl mucic acid with silver oxide and methyl iodide, and also by the formation of the methyl ester of 2 : 3 : 5-trimethyl β-methyl galactofuranoside, which after oxidation gave the γ-lactone methyl ester of 2 : 3 : 5-trimethyl mucic acid. Citrus pectic acid is thence supposed to be composed of pyranose residues of galacturonic acid joined by 1 : 4-α-glycosidic links. The molecule of the methyl ester of methylated pectic acid appears to be relatively small, the size as determined by osmotic pressure measurements being about 13 units. The methyl ester of 2 : 3 : 5-trimethyl β-methylgalactofuranoside was synthesized from methylgalactofuranoside and its structure determined by its conversion into the crystalline γ-lactone ester of 2 : 3 : 5-trimethyl mucic acid. Some derivatives of 2 : 3 : 5-trimethyl galactonic acid were isolated in a crystalline state.

Basic Nature of Vanadium Pentoxide

Although vanadium pentoxide V_2O_5 is a typical acidic oxide giving rise to series of salts (the vanadates) with bases, it has been known since the time of Berzelius that it is considerably more soluble in acids than in water, so that it also shows basic properties. Some solid compounds with sulphuric acid have been reported. These have been re-examined by O. E. Lanford and S. J. Kiehl (*J. Amer. Chem. Soc.*, 62, 1660; 1940), who find that only the solids V_2O_5, $4SO_3$, $4H_2O$, V_2O_5, $2SO_3$, $3H_2O$ and V_2O_5, $2SO_3$, $8H_2O$ are formed at 30°, no indication being found of the two compounds described by Berzelius. H. T. S. Britton and G. Welford (*J. Chem. Soc.*, 895; 1940) have examined the solubility of vanadium pentoxide in solutions of acids. The solubility depends on the strength of the acid and the temperature. Hydrochloric, nitric, perchloric, sulphuric, acetic and trichloracetic acids, and sodium hydrogen sulphate were used at temperatures of 180° and 100°. The action of acids in precipitating vanadium pentoxide from solutions of sodium vanadate was also examined, in this case at the boiling point, when reproducible results could be obtained, the oxide held in colloidal suspension being then precipitated. The results show that V_2O_5 is amphoteric and is an extremely weak base. Even in the presence of excess of acids it does not show a basic function extending beyond the ion VO_2^+. The specific conductivities and freezing points of acid solutions of vanadium pentoxide were also measured; the conductivities fell and the freezing points rose slightly as the vanadium pentoxide content increased.

RELATION OF MUSEUMS TO COMMERCE

By Dr. Walter E. Collinge,
The Yorkshire Museum, York

Commercial Museums

COMMERCIAL museums are no new idea. Spain has long had one at Mataro, there is one at Lima in Peru, and another at Santiago in Chile, and others in Mexico, Brazil, and Japan ; but the finest of all perhaps is that at Philadelphia. It arose out of the World's Columbian Exposition at Chicago in 1893. The vast exhibits there shown were secured and a permanent Board of Trustees and an Advisory Board appointed. This latter exercises a general supervision over the administration of the Museum with the object of furthering its development and fostering the efficiency of its service in the interests of commerce. Finally, there is a Diplomatic Advisory Board consisting of representatives of all foreign nations in the United States, with the object of ensuring international co-operation. In the first four years of its existence the city of Philadelphia provided £100,000 for the Museum.

The work is carried out in two separate departments, namely, a scientific department and a bureau of information. The former is concerned with the collection and exhibition of the raw products of the world, and the analysis and examination of all such materials. There is also an extensive exhibit of foreign manufactures, which shows samples of merchandise now being sold in foreign countries, especially in the markets of South America, Australia, South Africa, and other promising fields. The object is to show the American manufacturer what his competitors are doing in the foreign trade of these countries, and to suggest to him new lines of goods which he may produce and sell with profit.

The practical value of this department will at once be recognized. The manufacturer of cotton goods, for example, who is desirous of wider markets for his products, may here find thousands of samples, showing him in the greatest detail the styles of goods which are now being sold. He may inform himself concerning the weights, widths, lengths, and patterns which are in favour. Each sample is accompanied by the manufacturer's price. With this information the American manufacturer is put in a position to judge of any market as to whether it would be worth while for him to attempt to claim a share of its trade. Equal facilities are offered to manufacturers of hardware and cutlery, boots and shoes, hats, caps, woollens and many other lines of products. Novelties and improvements made by foreign manufacturers in standard goods and staples are promptly noted. By frequent additions this collection is equipped to give a good idea of important changes in the demand for any line of commodities.

The Bureau of Information consists of a reading-room provided with technical and trade journals, with the contents indexed ; consular and trade reports ; an index of firms, etc.

For many years past there has been a constant inflow into the Bureau of Information regarding foreign markets, foreign trade methods and foreign business houses. There is a collection of technical dictionaries, foreign catalogues, a Language Translation Department, a library of 4,500 volumes and 79,000 pamphlets, including the commercial statistics of more than a hundred Governments. Files of official tariffs, custom house regulations, banking methods, registration of trade marks, and commercial practices for all countries are also included.

The Commercial Museum covers a floor space of about 2½ acres, and the exhibits show the commercial products and the chief industries of all countries, and also illustrate the manners and customs of various races of men.

Many of the exhibits are arranged by countries, separate sections being assigned to Mexico, Brazil, Argentina, Peru, Bolivia, Chile, Cuba and other parts of the Western Hemisphere. In a like manner there are separate exhibits of larger size devoted to South Africa, Central Africa, North Africa, India, Japan, China, and the South Sea Islands. All these exhibits contain authentic samples of commercial products which are constantly being used for the help of American business men.

A separate series of exhibits, covering a large floor space, is devoted to classified collections of products. Here the visitor will find all the varnish gums brought together for the purpose of comparison, whether they come from America, Africa or the Far East. In another collection all the commercial varieties of cotton are displayed, whether grown in the United States, Brazil, Egypt, or India.

There are systematic collections of this kind illustrating such products as corn, wheat, sugar, tea, coffee, flax, silk, wool, gums, and resins, rubber, furs, leather, coal, petroleum, etc.

Exhibitions

At different times and in different places there are held great exhibitions and fairs, such as those in London, Glasgow, Paris, Toronto, etc. Taken more seriously these might be made very useful and of great commercial value ; but there is so much irrelevant matter introduced, and with better arrangements and greater pains taken in the art of exhibiting they might be greatly improved. In the United States, the administration and organization of such exhibitions is entrusted to a Board on which two or three individuals possessing a sound experience of museum administration and organization sit.

Training of Craftsmen

In British-made goods we not infrequently find an inferiority in design and artistic skill when compared with those of other countries. The workmen are not familiar with the masterpieces and the work of the great craftsmen. There is a lack of appreciation of symmetry, form, colour, design, etc. Unless we can quicken the mental life of the people and provide them with easily accessible standards of reference of the very best, both in the industrial and fine arts, we shall continue to fall behind. We must place before the rising generation the best that has been produced in the past and the best that is being produced to-day, and this will form the right basis on which they will build for the future. It is

in our art galleries and museums that this can be done best.

Man is an imitator and inventor, and his intellectual outlook and future is largely determined by his environment; he assimilates ideas from his surroundings and from these reconstructs new things. It therefore behoves us to provide the community with the highest and most perfect standards of reference. Our museums and art galleries must play a part in the normal life of the people. From the earliest school days right on through life these institutions should be made a source of interest, pleasure, and inspiration to all.

In woodwork, metalwork, stonework, and textiles, the museum can assist the craftsman in his technique. It can interest him in the past history of his craft, and as a result he will bring new ideas into his work, and such, of course, have a commercial value.

Speaking a few years ago to the National Association of Art Masters, the President said: "As an industrial nation, our very existence, as well as our prosperity, depends on our commercial enterprise. Therefore it is our duty to consider that aspect of the case, and find out how best Art Education can be brought into closer touch with the requirements of trade and the manufacturer, because when technical skill has done its best, it is the applied art that often determines the market value of the manufactured article. There is hardly a single marketable commodity that is not touched by art at one point or another before it reaches the purchaser."

Incidentally an ethnographic museum can be made of great assistance to industry. How often do we hear of and see manufacturers sending abroad textiles with designs that offend the susceptibilities of the natives or which are opposed to their superstitions or religious beliefs, whereas a very short study of the native-made mats, baskets, etc., would have shown the designs which are appreciated and in use.

"You will do the greatest service to the state," wrote Epictetus, "if you shall raise, not the roofs of the houses, but the souls of the citizens: for it is better that great souls should dwell in small houses rather than for mean slaves to lurk in great houses."

In our modern system of education "We strain the memory instead of cultivating the mind," as Lord Avebury said.

The objects in a commercial museum should awaken imagination, stimulate intelligence and inquiry, and place a higher and a truer conception of beauty before the visitors. The very environment should act upon the individual.

It is the museum and the art gallery which will cure our blindness. It is not necessary or good for us to walk about this world in a house that is dark, with eyes that see not, and here is the evil of the present day. We have a vast concourse of people who have been instructed but not educated. Lord Avebury some thirty-seven years ago wrote: "I fear that our present system does not really train the mind, or cultivate the power of observation, or even give the amount of information which we may reasonably expect from the time devoted to it."

COSMIC RAYS AT HIGH ALTITUDES*

By William P. Jesse,
University of Chicago

During the past year the cosmic ray investigators at the University of Chicago have carried out three different experiments to investigate some of the interesting phenomena associated with cosmic rays at altitudes of twenty thousand feet and higher. Marcel Schein and E. O. Wollan in collaboration with the author have been able by coincidence counter apparatus carried by balloons to determine as a function of altitude (1) the vertical intensity of the mesotrons in the atmosphere, and (2) the number of mesotrons generated in a block of lead 2 cm. thick by non-ionizing radiation. The mesotron intensity was found to increase rapidly with altitude up to a maximum value at about 6·6 cm. pressure and then to decrease. The production of mesotrons in the lead block becomes noticeable at an altitude of 5 km., and from this point on increases with altitude at about the same rate as does the soft component of cosmic rays.

In a second high-altitude experiment, by G. Herzog, a counter-controlled cloud chamber and magnet were carried in an aeroplane to a height of 29,000 ft. to obtain photographs of slow mesotron tracks. Mesotrons can be distinguished from electrons in a cloud chamber by reason of the increased ionization along the tracks only when the momentum of the mesotron lies within a range of relatively low values. Mesotrons of such low momentum values occur so rarely at sea-level that from thousands of cloud chamber photographs made at the surface of the earth not more than a dozen tracks have been clearly distinguished as mesotron tracks, and mass estimates made. Above twenty thousand feet such slow mesotrons were found by Herzog in much greater abundance. From 230 photographs obtained, more than twelve tracks could be definitely identified with the passage of a mesotron.

A third experiment, by the author, has consisted of a series of thirteen balloon flights in which an ionization chamber was carried up to an altitude of approximately 25 km. in an attempt to determine a possible time variation in the total intensity of cosmic rays near the top of the atmosphere. Time changes of more than fifteen per cent have been observed during the past year. Such changes follow quite closely the 'world-wide' variations of Forbush and others and are probably due, in part at least, to intensity changes in the magnetic field surrounding the earth. However, when the high-altitude values are corrected on the basis of ground values for the 'world-wide' variations, a residual effect remains with a maximum in the early spring and minimum in the late summer. Further experiments are necessary to determine whether this is a true seasonal effect.

* Substance of a paper read at the annual meeting of the U.S. National Academy of Sciences held during April 22–23.

FORMATION OF 3/2 ELECTRON COMPOUNDS IN ALLOYS OF COPPER, SILVER, AND GOLD

In many alloys of copper, silver, and gold with the elements of the *B*-sub-groups, the phase next to the α solid solution has a composition near that required by an electron concentration of 1·5, and for convenience these may be called the 3/2 electron compounds. The crystal structures of these are of three types: (1) body-centred cubic structures, either disordered (β) or ordered (β′); (2) close-packed hexagonal types (ζ or ζ′); (3) β-manganese type (denoted μ).

A review of the existing data by W. Hume-Rothery, P. W. Reynolds and G. V. Raynor (*J. Inst. Metals*, 66, 1940), shows that the 3/2 electron compounds are formed only when the size-factors are reasonably favourable, the term 'size-factor' being used to denote the difference between the atomic diameters of solvent and solute. A detailed examination leads to the following generalizations: (*a*) increasing valency favours the ζ or μ structures at the expense of the β or β′ structures; (*b*) increasing temperature favours the β structures at the expense of the β′, ζ, or μ structures; (*c*) increasing size-factor favours the β structures at the expense of the ζ or μ structures; (*d*) increasing the size-factor moves the composition of the 3/2 electron compounds in the direction of lower electron concentration, and also narrows the range of composition of the phases in terms of electron concentration; (*e*) the tendency to form ordered β′ structures in copper, silver, and gold alloys is in the order gold > silver > copper.

A review of the data shows that considerations of size-factor and electron concentration are not by themselves sufficient to explain the facts, but that an additional factor is present to an increasing extent, as the solvent and solute metals differ in their electrochemical properties. In their alloys with electropositive metals (such as magnesium or zinc), copper, silver, and gold are the electronegative members, and the electrochemical factors are in the order gold > silver > copper. In alloys with the electronegative elements (such as arsenic), copper, silver, and gold are electropositive, and the electrochemical factors are in the reverse order, copper > silver > gold. This reversal of the relative electrochemical nature of the solvent and solute takes place at about Group IV.

The tendency to form the β′ structures with long-range order is favoured by an increasing electrochemical factor, and, when this is sufficiently pronounced, the β′ liquids and solidus curves rise to a maximum, as in the system gold-magnesium. A consideration of the effect of the development of long-range order on the form of the equilibrium diagram leads to an explanation of the form of the copper-beryllium diagram. An examination of the phase boundaries of the equilibrium diagrams shows that, in many cases where the percentage of the solute is high, the diagrams begin to acquire characteristics that would be expected in ordered structures, even though X-ray investigations show that long-range order does not exist. It is suggested that a short-range order may be present, and it is shown that this conception accounts for the shapes of parts of the equilibrium diagrams, and for the limiting compositions to which some of the phase boundaries approach.

FORTHCOMING EVENTS

Tuesday, October 22

Illuminating Engineering Society (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 2.30 p.m.—Mr. H. C. Weston: "Industrial Lighting and the Black-out."

Wednesday, October 23

North-East Coast Institution of Engineers and Shipbuilders (Student Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 6.45 p.m.—Mr. George Wright, jr.: "Relative Merits of Marine Fuels". (Chairman's address).

Thursday, October 24

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Mr. J. R. Beard: Presidential address.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1939. (Twenty-fifth Report.) Pp. vi+132+6 plates. (London: H.M. Stationery Office.) 2s. 6d. net. [710

British Electrical and Allied Industries Research Association. Technical Report, Reference L/T 114: The Electric Strength of Solid Dielectrics in relation to the Theory of Electronic Breakdown. Pp. 18+9 plates. (London: British Electrical and Allied Industries Research Association.) 3s. [810

Other Countries

Field Museum of Natural History. Botany Leaflet 25: The Story of Food Plants. By B. E. Dahlgren. Pp. iv+33. (Chicago: Field Museum of Natural History.) 25 cents. [710

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 15: A Symposium on Social Progress. What is Social Progress? by L. J. Henderson; A Paper on Social Progress, by Crane Brinton; Social Progress, by Edwin Bidwell Wilson. Pp. 457–472. (Boston: American Academy of Arts and Sciences.) 50 cents. [710

Smithsonian Miscellaneous Collections. Vol. 99, No. 6: The Time Course of Photosynthesis and Fluorescence observed Simultaneously. By E. D. McAlister and Jack Myers. (Publication 3591.) Pp. ii+37. (Washington, D.C.: Smithsonian Institution.) [710

U.S. Department of Agriculture. Technical Bulletin No. 732: Arsenic Distribution in Soils and its Presence in Certain Plants. By Kenneth T. Williams and Richard R. Whetstone. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents. [710

Smithsonian Institution: United States National Museum. Bulletin 100, Vol. 14, Part 1: Contributions to the Biology of the Philippine Archipelago and Adjacent Regions—Report on the Echinoidea collected by the U.S. Fisheries Steamer *Albatross* during the Philippine Expedition 1907–1910, Part 2: The Echinothuridæ, Saleniidæ, Arbaciidæ, Aspipodiadematidæ, Micropygidæ, Diadematidæ, Pedinidæ, Temnopleuridæ, Toxopneustidæ and Echinometridæ. By Theodor Mortensen. Pp. iv+52. (Washington, D.C.: Government Printing Office.) 10 cents. [710

Indian Forest Records (New Series). Silviculture, Vol. 4, No. 1: Canadian Aerial Forestry for Burma. By J. D. Braithwaite. Pp. ix+96+18 plates. (Delhi: Manager of Publications.) 3.12 rupees. 6s. [710

United States National Museum. Bulletin 176: Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds and their Allies; Orders Psittaciformes, Cuculiformes, Trogoniformes, Coraciiformes, Caprimulgiformes and Micropodiiformes. By Arthur Cleveland Bent. Pp. viii+506+73 plates. (Washington, D.C.: Government Printing Office.) 75 cents. [810

Canada: Department of Mines and Resources, Mines and Geology Branch: Geological Survey. Paper 40-1: Preliminary Map, Jumpingpound, Alberta. By G. S. Hume. 1 map. 10 cents. Paper 40-6: Preliminary Map, Bragg Creek, Alberta. By G. S. Hume and H. H. Beach. 1 map. 10 cents. Paper 40-8: The Structure and Oil Prospects of the Foothills of Alberta between Highwood and Bow Rivers. By G. S. Hume. Pp. iii+22+1 map. 10 cents. Paper 40-10: Stony Rapids and Porcupine River Areas, Saskatchewan. By G. M. Furnival. Pp. ii+10+2 maps. 10 cents. Paper 40-11: The Lloydminster Gas and Oil Area, Alberta and Saskatchewan. By G. S. Hume and C. O. Hage. Pp. iii+12. 10 cents. Paper 40-12: Zeballos Mining District and Vicinity, British Columbia. By M. F. Bancroft. Pp. iii+39. 10 cents. Paper 40-14: Quyta Lake and Parts of Fishing Lake and Prosperous Lake Areas, Northwest Territories. By A. W. Jolliffe. Pp. iii+9. 10 cents. (Ottawa: King's Printer.) [810

NATURE

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Telephone Number: Whitehall 8831   Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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Registered as a Newspaper at the General Post Office

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NATURE

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Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704

FOOD SUPPLIES AND NUTRITION IN EUROPE

WITH the approach of winter, the problem of food supplies and nutrition in Europe is receiving much attention. Already it is clear that difficulties will have to be faced, and that they will present a major problem on the conclusion of hostilities. But the problem is, in fact, only a part of the much wider question of the planning of relations between food-importing and food-growing countries so as to clear the channels of trade, to regulate its even flow and to remove the arbitrary interference of national or individual self-interest. In his preliminary report to the Economic Committee on Standards of Living, Prof. N. F. Hall suggested that the principal need was a large variety of improvements and reforms, many of them small in themselves, but with cumulative effect through more or less simultaneous action by many Governments of very greatly increasing world economic activity. The intensification of Government efforts to increase efficiency and the reduction of costs in both production and distribution is an important means of progressively raising standards of living; and, particularly in regard to food production and distribution, measures forced upon us as part of our food policy in war-time may offer the prospect of considerable immediate advance after the War. The recent scheme for free or cheap milk in Britain represents the latest development of a policy begun tentatively before the War to increase the consumption of the protective foods, dairy products and fruit, of which the poor consume so much less than the richer classes.

It should be recognized, moreover, that the power which our blockade of Germany puts in our hands entails a special obligation of the British people to Europe. The power of the British blockade must be used not only to defeat the enemy of freedom in Europe but also to help Europe to restore and reorganize her strength and to create a unity of life and purpose. The fatal mistake of suspending at the end of the War of 1914–18 such organizations as the Allied Maritime Transport Council and the Supply Council must not be repeated. Mr. Bryant's haunting picture of famine over Europe in his recent book "Unfinished Victory" should ever be in our minds when we are tempted to face the peace unprepared.

So far as Germany itself is concerned, the effects on public health of the Nazi regime are described by Dr. Martin Gumpert in his recent book "Heil Hunger"*. The record affords a striking parallel to the picture of labour under Nazi rule which Dr. W. A. Robson drew in a recent Oxford Pamphlet. While the deterioration of intellectual activity in Germany in the last seven years as an outcome of the proscription of freedom of thought, teaching and speech is widely known, the price which has been paid in physical health for the Nazi achievements is far from being appreciated. Dr. Gumpert, like Dr. Robson, shows that even the "Strength through Joy" movement has an uglier side, and his book should supply a corrective, if any were still needed in Great Britain, to the perspective in which the methods by which even undoubted progress has been secured are viewed.

Dr. Gumpert's figures have been severely criticized by Dr. W. A. Brend in an article in the *Nineteenth Century*, and it is true that Dr. Gumpert has failed to present his statistics in comparison with those of other European countries. His assertion that six years of Nazi rule have led to an

* Heil Hunger! Health under Hitler. By Dr. Martin Gumpert. Translated from the German by Maurice Samuel. Pp. 128. (London: George Allen and Unwin, Ltd., 1940.) 5s. net.

increased death-rate and a falling birth-rate is flatly contradicted by Dr. Brend, who maintains that in some respects health conditions in Germany are ahead and in others only a little behind other leading European nations. Dr. Gumpert's statistics, however, are the least impressive feature of his book. Much more significant and impressive are the quotations from official German publications indicating concern with the results of policy or a deliberate disregard of considerations of health and welfare.

In spite of efforts to improve the health and working capacity of German students, the numbers of those physically inadequate steadily increases. Under-nourishment is officially admitted, simultaneously with the recommendation that those who are physically fit for sport should be excluded from courses of study. The systematic demand for over-exertion, the abrogation or evasion in various ways of the restrictions on child labour which had existed in Germany for decades, and the deterioration of standards of education, have already had dire consequences on the youth of the nation.

Equally sombre is the picture of the ruin of science drawn by Dr. Gumpert. With the outlines of this scientific workers are already familiar, but his chapter under this heading is more concerned with the way in which the standards of medical training, research and practice have been relaxed, opening the door to quackery and threatening a shortage of trained personnel. The impressive decline in the numbers of university students has been accompanied by a neglect and decay of vital physical and intellectual values in Germany which have already affected the military power of the country and its capacity for war.

It would be unwise to exaggerate the significance of this effect, but Dr. Gumpert clearly indicates that during six years of Nazi rule, Germany has been under the stress and strain which are associated with war rather than peace, with the usual effects on health. The really significant part of the book lies in those chapters in which, dealing with food consumption and diet, agricultural policy and the like, Dr. Gumpert indicates that Germany is to-day in the condition of a nation which has been carrying on an exhausting war for six years. The under-nourishment which exists in Germany is not comparable with the deprivation which reigned there in the latter part of the War of 1914–18 and afterwards. Its inroads on health are more insidious but may be equally far-reaching, and Dr. Gumpert refers to a memorandum in 1938 in which leading scientific men such as Abderhalden, Kuhn and others directed the attention of the Reich Government to the shortage of vitamin B in the food of the German people and to the need for a larger supply of fresh fruit and vegetables to safeguard the public health.

To what extent the position has been relieved by German expansion and the ruthless exploitation of the occupied territories during the past year is problematic. Even after the absorption of Austria and the Sudetenland, official spokesmen asserted that a 25 per cent increase in agricultural production was necessary for complete independence in food supply. The dependence of Denmark and Holland on imported feeding stuffs should prevent Germany from reaping more than temporary advantage from her despoilation of those countries.

The position appears to resemble that which developed towards the end of the 1914–18 period sufficiently closely to warrant the conclusion that Germany herself will be in no less need of relief than the occupied territories when Nazi domination is overthrown. It will be remembered that in undertaking to encourage the building up all over the world of food reserves destined for the relief of countries held by Germany, Mr. Churchill was careful to include the people of Germany itself and of Austria. The planning of post-War relief in this way might well be used by the Ministry of Information to develop more effective relations with the submerged democratic movements abroad, to strengthen them in their resistance to Nazi tyranny and to prepare the way for corporate planning after the War.

Such a task will involve the handling of the world's accumulated surpluses of primary products, which already represent a standing problem of modern world economy, exaggerated by the abnormal conditions of the War. The exportable surpluses of wheat in overseas countries may well exceed a thousand million bushels. Management of this problem is part of the larger problem of the re-organization of the world's agriculture and the direct treatment of poverty and malnutrition. To prepare now for this task, and to extend the survey to other aspects of European reconstruction —to problems of transport, of housing and public works, and of industrial reconstruction—would be a prudent anticipation of needs which must be met whatever political shape a liberated Europe may assume. It may indeed well prove that concentration on such aims—an improved level

of nutrition, higher standards of living, a more prosperous world agriculture, freer international trade and an increased volume of trade—interlocked as they are, may make a practical contribution to the future world order by affording opportunity between armistice and final settlement for passions and prejudices to die down, issues to be clarified and international understanding and co-operation to be fostered.

This approach to the economic needs of Europe cannot be made in isolation from the needs of Great Britain. The main responsibility for the defence of civilized Europe rests on Britain. The power that is ours carries also the responsibility for the initiative for the building up of a new Europe. As we recognize and discharge these twin responsibilities, we shall find that many of the solutions to our present problems of defence hold the key to the solution of post-War problems of reconstruction and readjustment, and that the policies best calculated to meet our own post-War needs are essentially part of wider policies designed, in co-operation with the Dominions and with the United States of America, to restore order to Europe, to relieve her necessities and to stimulate a new and progressive era of welfare and freedom.

NATURE AND PSYCHE

The Idea of the Soul in Western Philosophy and Science

By Dr. William Ellis. Pp. 314. (London: George Allen and Unwin, Ltd., 1940.) 12*s.* 6*d.* net.

THIS is a book of unusual interest. Many writers have discussed the influence which the investigations and theories of natural science have had on our notions of 'mind', 'soul' or 'spirit', but Dr. Ellis has had the brilliant idea of treating the question the other way round; of tracing historically the influence that the notion of the soul has had on the development of science. He has no difficulty in showing that the influence has been decisive at certain critical stages and has left indelible marks on the thought and language of western Europe.

The first point he makes (following A. E. Crawley in his "Idea of the Soul") is that this European notion of the soul is not primitive. For primitive man the 'soul' of anything—man, beast, or stone—is simply the mental image of it. When the nineteenth-century anthropologists attributed 'animism' to primitive man, they were simply reading in their own ideas and attributing to him distinctions which he is incapable of thinking and which his language cannot express. ". . . Animism, in the sense of a belief in the spiritual nature of the universe, is not a naïve, but on the contrary, a highly sophisticated view; indeed the mere conception of *spirit*, as we understand it and as the anthropologists of the last century understood it, was unknown before the Platonic, or Christian, idea of the soul. Animism in the sense we have defined could not in fact have existed before Socrates' discovery of the immaterial concept" (p. 92).

The Socratic or Platonic view is that there is on one hand a changing world of sensuous appearance, to which belong the human body and its passions, on the other the eternal world of forms, to which belong the human reason as displayed in theoretical knowledge and moral intuitions and also the mind of God. The first of these worlds, because it is changing, is only half real. In a famous passage in the "Phædo", Socrates contrasts the account that could be given of his sitting in prison waiting for death in terms of the position and motions of his 'bones and sinews', that is to say in terms of a behaviourist theory of physical causes, with what he considers the true account in teleological terms. "It was because he conceived himself as two beings, a corpse or puppet on the one hand, actuated by a detachable ghost on the other, that Socrates found behaviourism unthinkable" (p. 295). As Dr. Ellis points out, Socrates very unfairly fathers the behaviourist theory on Anaxagoras, because prior to Socrates himself the distinction between a material world of mechanical causation and an immaterial world of ends had not been drawn. Of late, behaviourism seems to have had its revenge on Socrates; but the manner in which that has come about is the result of the peculiar twist which the seventeenth century gave to the prevailing Socratic-Platonic tradition, largely owing to the influence of Descartes.

The material world for Descartes was entirely real but also entirely dead and possessed none but mathematical properties, but for that reason was amenable throughout to scientific investigation. The Cartesian view, in fact, provided a stimulus to science which was lacking in the Platonic. The sensible qualities of things, like colours and sounds, belonged to the material world for Plato, but for Descartes were mental and therefore immaterial and in themselves inaccessible to science. The experimental method of science consists in

determining general (preferably mathematical) relations between certain abstractions from perceptual experience; but it is only the abstractions and their mathematical relations that enter into the scientific account. Again the Cartesian view offers no difficulties initially. Almost at the birth of science Pythagoras found that musical intervals corresponded to certain numerical ratios, by plucking a stretched string stopped off at different lengths. In principle the experimental method can do nothing more than Pythagoras did: it remained only to exploit the method to the full in all possible regions of experience. This has now been done to a very large extent, but under the influence of Cartesian rather than Socratic ideas. However, the behaviourist method, which Socrates rejected, has successfully invaded what was considered the stronghold of the soul, conscious and intelligent behaviour. Naturally the exploration of living and conscious organisms by physical methods reveals nothing that is not physical. If vitalists, such as Driesch, deny this, the denial is self-contradictory.

From the point of view of scientific method there is everything to be said for behaviourism and nothing against it, but when it becomes philosophy on Cartesian lines there are certain difficulties. ". . . The function of 'scientific' theories is to explain the perceptively known in terms of the perceptively known. As soon as the philosophical behaviourist calls the perceptively known world (or rather abstractions from it) the 'physico-chemical' world, and then tells us he can explain experience in terms of the physico-chemical he has embarked on a task which metaphysics may or may not be able to achieve, but which science, from the nature of the case, cannot even attempt. For the fact of perceptual knowledge cannot be grounded in the perceptively known. Any attempt to find the ontological ground of perception in the perceptively known is a project, like that of lifting oneself by one's own boot-straps, doomed to self-refutation" (p. 266). The source of the trouble is that the mind which perceives and thinks has been treated as an epiphenomenon by the Cartesian tradition. We are asked to believe ". . . that thinking is in some sense unreal and that only matter is real, because thinking tells us that matter causes thinking" (p. 269). The trouble remains whether it is said, with the naive realist, that colours and smells somehow belong to the surfaces of material objects whether or not any one is looking or smelling, or whether it is said that matter itself has no perceptible qualities, in which case it is entirely unknown and unknowable. No compromise between these two views is possible; either matter is exactly as it appears or it does not appear at all. Positivism again, which is only "a misplaced application of scientific method" (p. 286), is no solution of a problem that cannot be dealt with by that method.

Dr. Ellis states his problem with admirable clarity. The methods of experimental science must be pursued rigorously to the very end. No metaphysical fiat of "thus far and no farther" can stop them. On the other hand, scientific method solves no metaphysical problems, and the problems of how we apprehend the world revealed by science and what that world is still remain. Platonic or Cartesian dualism makes a solution impossible. But, whatever our decision as to the nature of the material world may be, it depends on our decision as to the nature of the mind or soul and also as to the nature of the organism that links it to the material world. Dr. Ellis only sketches in rough outline his suggestion for a solution, and his account is not easily summarized without unfairness. It must suffice to say that, as a biologist by training, he is first of all concerned to contradict Descartes, for whom matter was necessarily dead, and to establish a position much more akin to Leibniz—and also to such present-day views as Prof. Whitehead's "philosophy of organism" or Prof. Stout's "animism". The life of any organism consists of interchange and reciprocal relations with the environment. If there is any truth in saying an organism is alive, then it cannot be true that the environment is quite dead. The other main point Dr. Ellis makes is that there must be a hierarchy of forms or systems in Nature such that the higher, though not entirely disparate from the lower, display characters not apparent in the lower. The view is not unlike the doctrine of "emergents" elaborated by Alexander. It also leads him to the Leibnizian conclusion that matter is momentary mind, that is to say, what mind would be reduced to if it lacked all memory and foresight.

The one serious defect of the book is the unfair and indeed scurvy treatment of Aristotle. Admittedly his views did not greatly influence the main European tradition and admittedly they are confused by cross currents of Platonism, but he did attempt something better than the notion of a "corpse or puppet actuated by a detachable ghost". It would not be altogether unjust to call Dr. Ellis's own conclusion Aristotelian. There are a number of minor defects in the book. They include some irritating misprints, a certain slackness in giving references to the less-known authors mentioned and a few loose and excessively sweeping statements. A useful addition would have been some treatment of the post-Socratic attempts to give a purely materialist account of the soul. However, these are small blemishes in a most valuable work.

A. D. RITCHIE.

INTROVERTED SCIENCE

The Integration of the Personality
By Dr. Carl G. Jung. Translated by Stanley M. Dell. Pp. iv+313. (London: Kegan Paul & Co., Ltd., 1940.) 15s. net.

IT will be interesting to see how this book with its steady introverted illumination of the psychic interior succeeds in overcoming the mental black-out of the War. Its main contents first saw the light in an ideal setting on the lovely edge of Lake Maggiore a mile or two from Ascona. The place, the speakers, the enthusiastic and hospitable convenor and the company of people all contributed to the making of a unique spiritual atmosphere in which inner realities could be discussed in their own right. These papers need to be read with this setting in mind. Prof. Jung is telling all those who are interested what the process of individuation actually consists of and what it involves as a real-life adventure. But he is also, and first of all, a great empirical man of science, and is therefore concerned to display this rather special field with scientific objectivity and detachment.

The first lecture is concerned with the meaning of individuation as a general psychological process; the process which aims at making a human being "a unique indivisible unit or 'whole man' ". This comprehensive introduction to the subject is followed by a short study of a patient who began spontaneously to paint her symbolical way towards the centre. The author then gives an excellent description of the principal figures or archetypes of the collective unconscious through which the psychic realm of the non-ego is experienced. These introductory chapters are clearly not intended to give an exhaustive description of the phenomenology of individuation. Rather one gets the impression that the author is outlining the ground-plan of the science of being, leaving the elaboration of the main edifice for a fuller work.

In effect, individuation is a solitary experience: it is therefore not everybody's medicine. It must be admitted that in so far as the experience remains irrelevant, this book will seem unintelligible. There are many for whom the idea of psychic value, the treasure difficult of attainment, the "purple hall of the city of jade", the "golden flower", bear no meaning and invite no response. We may even find eminent psychologists among these excluded sons; in which case their comments upon the book are more than likely to be superfluous. The goal of extroverted science has so far lain in the world of external and therefore verifiable phenomena. The goal of the introverted science of being is naturally incommensurable with that of its worldly and more successful twin. Yet science must embrace both. As Jung shows in the chapter on dream symbols of the process of individuation, the tendency towards psychical integration arises quite spontaneously at a certain phase of life and frequently becomes the major motive. In the next chapter he demonstrates the continuity of tradition through the history of alchemy, proving that the same symbolic material, which now appears within the individuation process, manifested itself in alchemy in the form of quasi-material projections. Since, therefore, individuation is a process of Nature which develops its own peculiar transformations within the individual psyche with a certain regularity, it follows that its study must eventually be incorporated within the body of science.

The chief obstacles in submitting the evidence to a general verdict are twofold. The first, exemplified to some extent in the present work, comes from the prolific nature of subjective material. The second, more serious still, comes from the fact that people who are outside the experience obstinately persist in regarding psychical material as unreal and imaginary. Thus a quandary is created; since those within the experience find the required elaboration of evidence superfluous, while those without will never even consider it. Actually, in the author's selection of relevant material in the very interesting dream-sequence of Chapter iv, insufficient evidence is provided to support some of the author's conclusions. Here and there one feels the need for more material and for a fuller knowledge of the subject's personal psychology in order to bridge the unavoidable gaps in the selected material; whereas in "The Idea of Redemption in Alchemy" the author gives a completely satisfying psychological explanation of that bewildering stream of tradition which carried the developing germ of individuation from antiquity to the Reformation.

In these two chapters Jung has begun to make the bridge between the individual process of healing within the modern soul and the central ideas of the alchemical quest. The present work is in the nature of a pontoon. It demonstrates that psychic continuity with the past can surely be established. But the great work which represents the actual construction of the bridge has yet to be done.

The translation from the German has been done with exceptional skill.

FUNDAMENTALS OF ELECTROCHEMISTRY

(1) The Principles of Electrochemistry
By Duncan A. MacInnes. Pp. 478. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 30s. net.

(2) Theoretical Electrochemistry
By N. A. McKenna. Pp. xiii + 470. (London: Macmillan and Co., Ltd., 1939.) 15s.

THE introduction of the activity concept by Lewis and his collaborators, and the development of the interionic attraction theory by Debye, Hückel, Onsager, and others, have stimulated interest in certain aspects of electrochemistry, particularly those dealing with conductance, transference numbers and electrode potentials. The researches in this field of physical chemistry have fallen mainly into two categories; these are, first, improvements in experimental technique for the purpose of providing more accurate data for testing the theories that have been proposed, and secondly, extensions of the theoretical treatment so as to include the behaviour of relatively concentrated solutions. The advances made in recent years have opened up new vistas in the study of strong electrolytes, and hence it is not surprising that, almost simultaneously, two books were published, one in England and the other in the United States, dealing with the fundamental principles of electrochemistry.

(1) In the preface of his book, Dr. MacInnes, who has made a number of significant contributions to our knowledge of transference numbers, conductance, cells with liquid junctions, etc., states that his object is "to furnish an account of theoretical electrochemistry as it is to-day". The first chapter is introductory and historical; then follow sections on Faraday's laws, electrolytic conductance and transference; the latter, as is to be expected, is particularly good. In the two succeeding chapters the essential thermodynamic principles are given clearly and concisely; it may be mentioned, however, that the symbols used by the author are not those in common use either in Great Britain or in the United States. The table on p. 104, in which the thermodynamic symbols employed in a number of familiar texts are compared, emphasizes the necessity for some form of standardization in this respect.

The next eleven divisions deal with various aspects of electrode potentials and their applications, the concept of activity and the Debye-Hückel theory and its extensions. The subject of electrolytic conductance is taken up again in the three following chapters, which deal with the Onsager theory and the use of conductance measurements in various fields of physicochemical investigation. In the last three chapters of the book the problems of dielectric constants and dipole moments, electrokinetic phenomena, and irreversible electrode behaviour are discussed briefly.

Although this book by Dr. MacInnes deals with the theoretical principles of electrochemistry, the outlook may be described as essentially practical. The experimental methods are explained fully, and the best available data are quoted to illustrate the principles and to test the various theories that have been proposed. The derivation of the important equations is given in detail; nevertheless, the reader does not get the impression that electrochemistry is almost entirely a theoretical subject. The author points out that electrochemistry is now so extensive that he has been compelled to make an arbitrary selection of topics, and he has very wisely chosen to treat in most detail those matters with which he has been actively concerned in his own researches. The space—13 pages—devoted to irreversible electrode phenomena, including passivity, is, however, liable to give a false impression to readers not familiar with this branch of electrochemistry; in some respects, therefore, it might have been better to omit this section entirely. The treatment of transference, conductance and E.M.F.'s is exceptionally good, and so far as these subjects are concerned the book constitutes a major contribution to the literature of physical chemistry. The text is remarkably free from misprints, and the whole work shows signs of exceptional care on the part of author, printer and publisher.

(2) The second book under review covers very much the same ground as that already considered; the author's guiding principle has been the Debye-Hückel theory, and once more the subject of irreversible electrode processes, the Cinderella of electrochemistry, is dismissed in a mere 17 pages. The outlook in the two books is, however, fundamentally different, for the one by Mr. McKenna gives the impression of being essentially theoretical in character. The main emphasis appears to be on the derivation of equations, and not so much on their experimental verification. It is true that there are descriptions of experimental methods, and that the book contains 109 figures, many of which constitute graphical representations of experimental results, but there are very few tabulations of data. The reviewer has sought in vain for tables of transference numbers, of ionic

and equivalent conductances, of activity coefficients, or of standard electrode potentials; these, at least, might be expected in a book on electrochemistry. Further, the erroneous use of "ln", where logarithms to the base 10 are intended, diminished the value of certain of the figures.

The derivations of the Debye-Hückel, Onsager, and other important equations, as well as the modified treatments of Gronwall and LaMer, of Bjerrum, and of Fuoss and Kraus, are given in more detail than is generally found in text-books, and many readers will be glad to have this material in an accessible form.

It is unfortunate, however, that what might have been a useful book is marred by a number of errors and inconsistencies. The following, among others, have been noted: p. 87, nitrobenzene is described as a proton donor; p. 88, the mobilities of the ions H_3O^+ and OH^- are said to be smaller than the mobilities of the corresponding ions in alcohols; p. 231, equation (347) is incorrect; p. 240, the interpretation of equation (363) is erroneous; p. 271, the antimony electrode is not "widely used as a substandard" in place of the standard calomel electrode; p. 309, the curves for different oxidation-reduction systems are not always parallel; p. 400, an aliphatic amino-acid is said to show "complete acid and base dissociation at the iso-electric point"; p. 417, the value recorded for the ionic product of water is far from being "one of the most accurate" available. There is much confusion of signs in the chapter on reversible cells, and the equations are not consistent with those derived in the section on thermodynamics.

A reader of sufficient experience not liable to be misled or confused will, however, find in this book much useful and interesting material concerning the theory of electrolytic solutions.

S. Glasstone.

KINETIC THEORY OF GASES

An Introduction to the Kinetic Theory of Gases

By Sir James Jeans. Pp. vi + 311. (Cambridge: At the University Press, 1940.) 15*s.* net.

In 1904 there appeared a slender volume entitled "The Dynamical Theory of Gases", in which the author, now Sir James Jeans, endeavoured to develop the theory "upon as exact a mathematical basis as possible". It was an original and somewhat severe book, the reader being at once confronted with the difficulties of the law of distribution of molecular velocities and with statistical mechanics and the controversies and unresolved problems on the equipartition of energy. At that time the English student whose reading was confined to his own language had to choose between the somewhat arid treatises by Burbury and by Watson, or the translation of Meyer's attractive, almost chatty, but unmathematical book. Jeans' book, which was much more akin to Boltzmann's elegant "Vorlesungen über Gastheorie", found acceptance, despite its severity, and many of to-day's physicists, as well as mathematicians, were 'brought up on it' so far as gas-theory was concerned, and looked to it as to an oracle, sometimes difficult to fathom as is the way with oracles.

In 1916, 1921 and 1925 new editions were issued. The difficulties concerning equipartition—Lord Kelvin's "Nineteenth Century Clouds over the Dynamical Theory of Heat"—had by then "to a great extent been dissipated by the development of the Quantum Theory, a theory explained in its proper place . . ." in the second and later editions. The account of the quantum theory, thus given, was among the first published in English, at a time when the theory was being developed almost wholly in other countries.

The subsequent enormous growth of the quantum theory led to the publication of many treatises upon it. These, together with the appearance of such works as R. H. Fowler's "Statistical Mechanics", decided Sir James Jeans to transform his "Dynamical Theory of Gases", on the exhaustion of the last edition, with the result now under review.

Among the first things the usually impecunious student may note about it is that the new "Introduction to the Kinetic Theory of Gases", though about three quarters the size of its predecessor, is only half the price—a welcome and almost miraculous reversal of the general trend in book prices, made possible, doubtless, by the wide circulation likely to be gained by any book by Sir James Jeans. The format is also smaller, less imposing and less forbidding, as befits a book intended less for the mathematician than for "the serious student of physics and physical chemistry".

The principal negative change in the book is the omission of all save a bare reference here and there to the quantum theory and wave mechanics, which do not appear even in the index; another omission is that of the brief chapter on aerostatics

and planetary atmospheres, a subject the growth of which now demands a book (still wanting) to itself. Apart from these omissions, the major part of the "Dynamical Theory of Gases" is preserved in this book, often in the same words; but the order is changed, and several interesting interpolations are made, dealing with such subjects as Perrin's experiments on the Brownian motion, and the experimental verification of Maxwell's law of distribution of velocities by Dunoyer, Stern and Gerlach and others. Features in which the book is deficient, by comparison with other recent treatises (such as those by Loeb or Kennard), are the phenomena of gases at low densities, fluctuations, and the electric and magnetic properties of gases (the word mobility, for example, is not even in the index). It is for the author, however, to determine his own scope, and for the purchaser to decide whether or not he is suited by the result; there can be little doubt that, judged by the text, the book will deservedly succeed, and maintain for many years to come the already long association of the author's name with his present subject.

S. Chapman.

ELECTRICAL EFFECTS AT CHEMICAL BOUNDARIES

Electrocapillarity
The Chemistry and Physics of Electrodes and other Charged Surfaces. By Dr. J. A. V. Butler. Pp. x + 208. (London: Methuen and Co., Ltd., 1940). 12*s*. 6*d*. net.

Matter being fundamentally electrical in nature, it is impossible to have two materials of different chemical composition which are not also different in electrical constitution. When different materials come in contact in such a way that electrical forces can produce observable effects, such effects are invariably present. They may arise through the materials being conductors, so that electric current may flow across the boundary, or through the boundary being deformable, so that electrokinetic effects, in the widest sense, may arise. Dr. Butler has neither written a long treatise on the whole vast subject, nor a brief general introduction to it, nor again has he chosen but one particular aspect. The selection of subjects has been made, as he explains in his preface, by avoiding those which he feels to have been adequately treated in other works, and by concentrating chiefly on those in which he has become, through his own researches, most interested. To the general reader, the book will therefore appear to lack balance though not interest. To a student interested in some particular point, it may prove to be informative, stimulating or wholly silent. The reviewer feels, therefore, that his chief task should be to summarize the subjects dealt with.

Although modern work on the response of nerve and muscle tissue to electrical stimuli has been left out of the scope of the book, it is Galvani's early observations on this subject which introduce us to the voltaic pile in the first chapter. This carries us quickly through ideas on the origin of electromotive force to the thermionic work function and quantum mechanics. A condensed chapter on thermodynamics follows, and then a fuller discussion of the mechanism of reversible potentials.

In the fourth chapter, a general discussion of electrical double layers, the distribution of ions in them, their capacity and experimental methods of studying them, is preceded and followed by a more specialized discussion of electro-capillary curves. The author accepts the letter of Guggenheim's contention that the single potential difference between two phases has no physical meaning, but appears to reject the spirit of it. Classical electrical theory can define potential differences exactly in terms of the work of transfer of abstract electric charges. The abstraction is justified only so long as a process begins and ends in matter of the same kind. In dealing with phase boundaries, we must be concerned frequently with inseparable electrical and chemical transfers: our exploring unit charge must be carried by an atom which is usually more affected by its chemical than by its electrical environment—or perhaps one should say by its micro- than by its macro-electrical environment. The reviewer feels this problem to be so fundamental to the whole subject that he could have wished it to be more explicitly dealt with. The diffuse part of the double layer, where this problem is of less importance, is dealt with again in the next chapter, which is concerned with electrokinetic phenomena in general. The author points out that the Faraday Society's discussion on this subject appeared too late for inclusion of reference to it in these chapters.

The remainder of the book deals with electrode reactions of various kinds. The lion's share of attention is claimed by the confusing subject of over-voltage, which the author has made remarkably intelligible. Deposition of metals and the formation of oxide films are discussed more briefly, and the book concludes with a short account of electrolytic oxidation and reduction.

G. S. Hartley.

ARCHÆOLOGICAL JOURNEYS IN WESTERN PERSIA

Old Routes of Western Īrān

Narrative of an Archæological Journey carried out and recorded by Sir Aurel Stein. Antiquities examined, described and illustrated with the assistance of Fred H. Andrews. Pp. xxviii+432+97 plates. (London: Macmillan and Co., Ltd., 1940.) 42*s*. net.

UNTIL less than twenty years ago, excavation in Persia for archæological research was restricted by treaty for the French Government, and it is accordingly to the French Mission that we are chiefly indebted for our knowledge. The activities of that Mission have been confined to western Persia; even when restrictions were removed and American expeditions undertook work, it was on sites in western or central Persia that interest centred. The consequence has been that, especially during the last ten years, a formidable *corpus* of material has accumulated and a large literature has served to place research at the service of field workers. In archæology, as in other scientific work, aims and methods are likely to vary in accordance with the stage of knowledge reached. In western Persia there is now no need for pioneer work, and no excuse for pioneer methods in digging or publication.

More than ten years ago, Sir Aurel Stein began travelling in eastern Persia, and since then he has covered the eastern and southern border-lands. There he was doing pioneer work. The archæological material he found, necessarily confusing owing to the circumstances of discovery, had considerable value because it showed the nature of the archæological material to be expected in hitherto untapped sources; it created problems, and showed where and how they might be solved. His last journey, however, was devoted to the west, ground by no means unexplored, but containing many unexplored sites. It is extremely doubtful whether any good purpose is served by soundings at these sites unless an expedition is fully equipped; the report on soundings undertaken can only increase doubts on this matter.

The account of the actual journey is pleasantly written and strongly reminiscent of early nineteenth century travellers. But the book seems to be intended as a final record of "new finds of great antiquarian interest", in the manner of Sir Aurel's publications of his eastern journeys. Attention was given to four classes of antiquity, architectural remains, rock reliefs, a queer collection of statuary from one site, and pottery and small antiquities of early periods from many sites.

The architectural remains, mainly bridges, do not add to our knowledge more than the fact of their existence. The rock reliefs—why does Sir Aurel entertain such an affection in 1940 for *relievos* ?—are inadequately described, and the pictures are too small to be of use. This is most unfortunate. Good drawings, a minute description, full discussion of one set would have been infinitely preferable to the inadequate report on several here given. Tang-i-Sarawak especially deserves, and some day must receive, fitting publication which alone was now necessary as a record. There seem to be hints in the text that this monument may be Parthian, though there is no explicit statement; this seems very unlikely, but is a matter of interest and importance. The traveller hurries on.

At the village of Shami the local people had just found some statuary in bronze, which will for many years constitute an archæological puzzle. Sir Aurel Stein, like M. Godard and M. Seyrig, who have both published scientific discussions, is convinced that a large statue of a man wearing typical trousers and a long moustache is Parthian. Of this there is not the slightest tangible proof. The dress is only similar; it is not the same. The head does not point to such a date, even if it belongs to the statue (the set of the neck on the shoulders is very odd); it cannot be earlier than the establishment of Roman portrait types in the East, and is probably later than Palmyra and Gandhara. Fortunately, Sir Aurel was able to plan the remains of a building in which this statue and some other fragments were found. He calls it a shrine, chiefly because he identifies certain small structures as altars; he then decides that a Hellenistic mask done in the style of the Alexander heads, a type constantly copied in the debased Hellenistic work of the East, "represented a royal personage, whether Alexander the Great whose worship prevailed for a considerable period throughout the Hellenized East, or also a Seleucid monarch. Its presence in the ruined shrine throws a significant light on the cult to which it was devoted". In fact, it is historically impossible to suppose that there was a cult of any Macedonian king at Shami when the large statue was made, and the mask may be earlier than the building, but cannot be much earlier. A careful examination at Shami should lead to a different conclusion.

But the greatest lack in the book is an adequate report on the soundings made and on the pottery found. Most, if not all, of the pottery belongs to perfectly well-known classes; what is wanted is

more information about the circumstances in which it was found. At Hasanlu, for example, there was a wonderful opportunity to investigate strata in which a highly distinctive form of pottery belonging to the early centuries of the first millennium occurs. The chance has been missed, and the publication of the pottery itself can only be called inadequate. Sir Aurel should have allotted more space to Mr. Andrews for technical descriptions, in the manner which can alone satisfy scientific requirements.

On the whole, then, this book from a veteran's hand will prove a disappointment to students; lovers of travellers' books will find it admirable. The publishers have made it a pleasant book to handle and read. SIDNEY SMITH.

CELL "RADIATIONS"

The Secret of Life
Cosmic Rays and Radiations of Living Beings. By Georges Lakhovsky. Translated from the French by Mark Clement. Pp. viii + 201. (London: William Heinemann (Medical Books), Ltd., 1939.) 10*s*. 6*d*. net.

GEORGES LAKHOVSKY is an engineer who, struck by the idea that radiation might be concerned in the peculiar phenomena of life, formulated a hypothesis and has collected evidence in support of his views. Reduced to its simplest terms his theory is that the cell, as the unit of life, is an electromagnetic resonator, capable of emitting and absorbing radiations of very high frequency, that life is the harmony of multiple radiations of all the cells in a body reacting upon one another, and that disease is a disequilibrium introduced from outside into the cell-harmony.

There is evidence that certain creatures are susceptible to vibrations beyond human sensitivity, and even that some may emit such vibrations; but the author's knowledge of animal life is so limited that improbable examples are mixed indiscriminately with probable. For example, he suggests that lemmings occasionally require fishes for food, and on that assumption he explains the migrations of lemmings, which may reach the sea, as being the response to radiations from shoals of marine fishes (p. 36). Response is due to auto-electrification produced by an animal when it waves its tail in the air; the lemmings would have difficulty in performing that feat. The zoological standard is suggested by "amongst nocturnal birds let us take the bat as an example" (p. 35), or by the inaccurate statement that terns (called sterns) perform a series of circular movements in the air before alighting to fish in the waves (p. 46), though the translator is responsible for the "alighting", which is not expressed in the original text.

The theory, however, is based upon the structure of the cell and by that must be tested. The nucleus is said to be the seat of radiation. This is due to the chromosomes or nuclear filament, described as tubular, composed of a core of organic materials or mineral conductors surrounded by an insulating membrane of cholesterol, plastin and other dielectric substances; so that the twisted coil constitutes an electric circuit endowed by construction with self-inductance and capacity, which may be compared to an oscillating circuit. The description is so far removed from known facts, and the illustrations of chromosomes which accompany it are so crude, that even in this matter, all-important from the point of view of the hypothesis, the knowledge of the author becomes suspect; and the suspicion is confirmed almost on the next page where a description and a figure said to be of *Corynactis viridis*, a "marine organism measuring but 0·1 mm.", is no more than part of a stinging cell of that sea-anemone, and the "oscillating circuits" are the thread of the cnidocyst, the primary purpose of which has certainly nothing to do with emitting radiations.

It may be that cells emit and receive radiations, but the hypothesis is not substantiated by these tenuous speculations. Since the basis of the theory fails, it seems unnecessary to examine the other claims of its author. His multiple wave oscillator, to which a special appendix is given, may work and apparently has worked marvellous cures in cases of cancer, goitre and enlarged prostate, but that does not prove that its electric radiations acted upon hypothetical cell-oscillations; nor is his statement that fever causes the death of cells by "melting" the insulating membrane of nuclear filaments likely to be taken seriously.

We have discussed the weaknesses of this revelation of the secret of life at more length than may seem necessary, because the author and his translator consider that biologists and particularly British biologists have neglected the theory. The translator suggests that the backing of Prof. d'Arsonval indicates exceptional merits in the work; but it is only fair to say that d'Arsonval's preface is frankly non-committal.

JAMES RITCHIE.

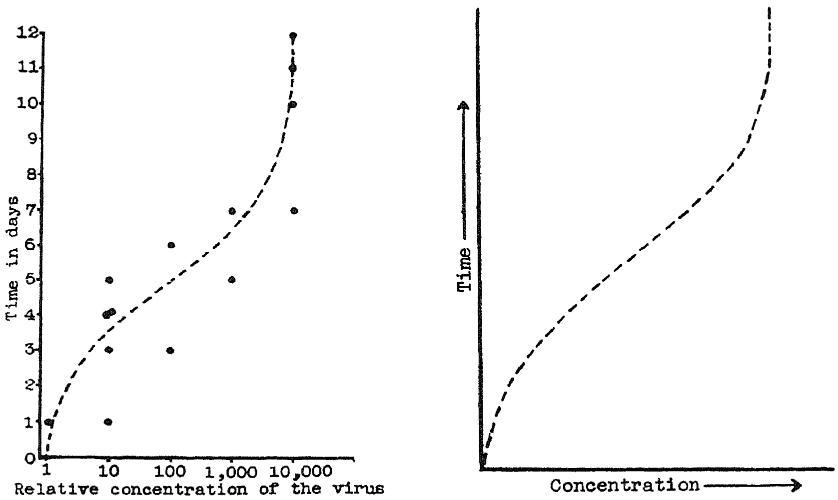
VIRUS AND VITAL ORGANIZATION

By Dr. John Grainger,
Tolson Memorial Museum, Huddersfield

RESEARCH workers who deal with virus diseases have many brilliant pieces of investigation to their credit. The study of little more than a decade has elucidated the size of different virus particles, the nature of virus protein, and its reactions as an immunological agent; the patient inquiry into virus pathology has now made possible a general review of the problem. A recent book[1] by Dr. Kenneth M. Smith, one of the foremost authorities on the subject, still says, however, that it cannot yet be said whether the virus is living or not, and many modern reviews of the problem[2,3,4] testify to the intense, though still unsatisfied, interest in this particular question. It is, indeed, of fundamental importance to determine whether virus is the smallest living entity or the most complex of non-living phenomena; it is already conceded by most research workers that it occupies a position intermediate between these states, having affinities with both.

The chief difficulty is to define the qualities which separate living from non-living matter. The older biological dicta that reproduction, irritability and movement are the main criteria are no longer tenable without qualification. Reproduction, as exhibited in bacteria, the lowest form of life accepted at present, has a direct parallel with the rate of increase of one product in a non-living, autocatalytic reaction (Fig. 1). One has, indeed, merely to transpose chemical and bacteriological nomenclature to see the complete similarity. The bacteriologist says a bacterium acts upon a culture medium to produce more bacteria; the chemist states that an autocatalyst acts upon another substance to produce more of the autocatalyst. Reproduction in its simplest form, therefore, is not a reliable character for the separation of living from non-living. Irritability, if conceived as a reaction to external stimulus, is of even less value, since inanimate objects respond implicitly to outside forces such as temperature, magnetism, contact, light, and other factors of the environment.

Movement may also be a response to external stimulus such as gravity, but autonomous movement, or motion controlled by the organism itself, gives the first real clue to the quality of life.



(a) (b)

Fig. 1.

(a) Rate of increase of Nicotiana virus 1 in tissue of *Nicotiana tabacum*.
(b) Rate of increase of the autocatalyst in an autocatalytic reaction.
The *S*-curve is also characteristic of the rate of increase of bacteria, and of other growth-rates.

Living things are not completely at the mercy of their environment, whereas non-living matter has a totalitarian subjection to external surroundings. Thus a non-living mass of protein always rolls down a slope with unquestioning obedience to the law of gravity; living protein in certain forms *can* move up the slope, following its internal direction. It does not always do so; gravity is often the dictator, but the living organism is not completely subject to the laws of gravity. Motile bacteria can move against a slight stream of liquid; inanimate particles are always carried with the flow, or left stationary. The organization of evolution can, I think, be conceived as having three departments: the non-living, which is completely dependent upon its surroundings, the living, where independence of the environment exists in varying

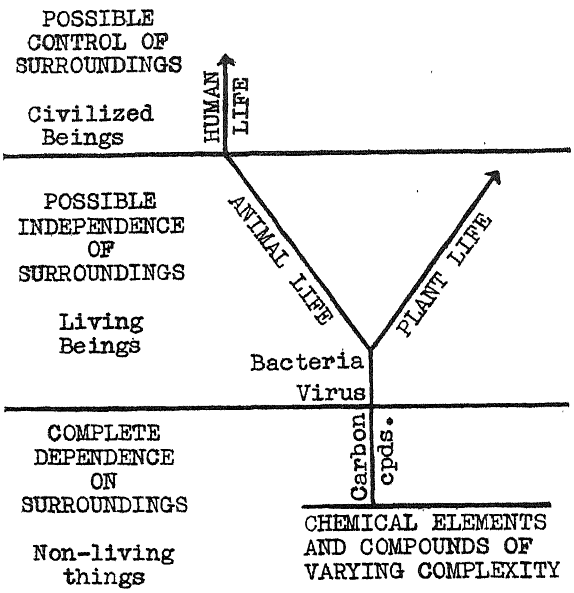


Fig. 2.

Diagram to show the relations of civilized and living beings with non-living things.

degree, and civilized humanity, where some measure of control of external events and conditions is possible (Fig. 2).

The virus multiplies within its host, and also moves therein. Is this motion subject to the host, or does it exhibit any degree of autonomy? Results from such an inquiry ought to show whether the virus possesses any claim to vital organization. A plant host is particularly suitable for such studies, since it eliminates the gross circulation of a bloodstream and provides gentle barriers, more amenable to investigation.

It is a well-known fact that a tobacco plant can be infected by inoculating Nicotiana virus I into the epidermal cells of the stem. The virus can later be recovered from all parts of the plant, thus involving a transfer across the relatively inert cells of the cortex, where protoplasmic streaming could not provide an aid to progress, and where the static conditions of osmosis or of salt concentration within the cells are probably the dominant forces. The rate of travel is too great for an explanation in terms of diffusion[5,6]. Here, then, is *prima facie* evidence that virus movement is not necessarily dependent upon the streams of nutrient, water or protoplasm which are known to be present in the green host plant.

It has also been shown[5] that virus can multiply within a tobacco leaf severed from the plant and kept in a humid atmosphere. Here the various streams of transpiration and translocation within the plant are eliminated, yet the virus advances in a wave down the leaf, following inoculation at the tip. It may even move faster than in a similar leaf attached to the plant, and can be detected in the lamina of the leaf before it occurs in the midrib, thus demonstrating the elimination of mechanical transport along the conducting tissues. It is noteworthy that tobacco leaves scratched with a sterile needle at the tips, as for inoculation, and then dipped in red ink solution, did not permit any transfer of the inanimate dye. Similar results can be obtained with detached stems; the virus spreads upwards and downwards at about the same rate (Fig. 3), and appears to be independent of any help from the host. It does not seem to make any difference if a bias is given to the transpiration stream by leaving one or two leaves upon the detached stem[5]. In so far as the passage of a dye can be regarded as an indication of the transpiration stream, it very often follows a course different from the virus. Red ink taken up from the cut end of a shoot penetrates the vascular ring of the stem and enters the lower leaves first; the virus often proceeds first to the youngest leaves. Transport to the growing point by the stream of elaborated nutrients in this case appears to be ruled out by the fact that virus spreads downwards in the stem at about the same rate as it moves upwards[5]. Carriage of the virus by protoplasmic streaming would require a linear rate of movement; Fig. 3 shows that the virus has a logarithmic rate of travel, which could, moreover, be given by a population increasing in geometric progression and free to orientate themselves into the first new tissue they reach within the parallel confines of a stem. The similar rates of upward and downward movement again eliminate the possibility that protoplasmic streaming might carry the virus predominantly in one direction.

In the matter of temperature also, virus is not completely dependent upon its host. It does not

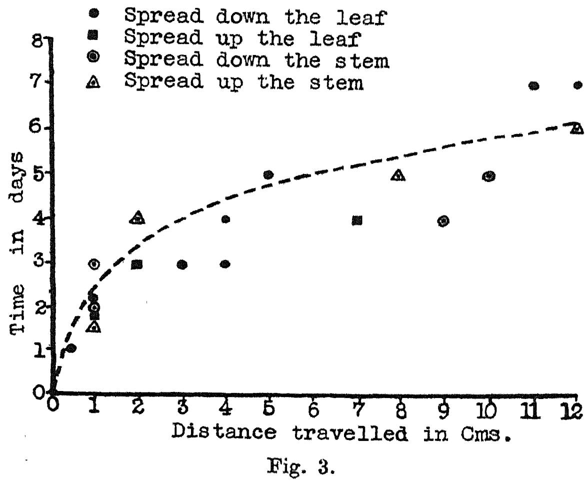


Fig. 3.

The rate and manner of spread of Nicotiana virus I in leaf and stem tissue of *Nicotiana tabacum*, following a limited inoculation.

produce symptoms at all temperatures at which the host will grow, though virus is present in the tissues[7,8,9]. The virus, moreover, has a temperature of optimum activity different from that of its host[7,8], thereby exhibiting a degree of independence of the plant which it attacks.

It now seems possible to suggest that the virus is actually a living organism, since it exhibits a type of independent movement through its host which can only be interpreted as autonomous, and shows further independence in the calibre of its temperature relations. It is not yet possible to envisage the actual mechanism of the movement. Sheffield[10] has produced categorical evidence that protoplasmic connexions between cells are necessary. The experimental evidence, however, seems to indicate the broad fact of virus autonomy.

The results of many workers, notably Stanley and Bawden and Pirie, show that the virus is a crystalline protein, different from the usual biological conception of such substances. This has been interpreted as an argument against the living nature of the virus, but cannot, I think, be an overwhelming criterion. Difference in structure between the protein of fungi and bacteria must have seemed great at the time of its discovery—as large as the known differences between bacterial and virus protein. Moreover, virus is not always crystalline; it may occur as amorphous inclusion bodies, which look much more like the traditional proteins of biology. The lack of demonstration of virus respiration is not a significant difficulty, for it is impossible to separate bacterial respiration from changes of the substrate brought about by the organism; both bacteria and virus disturb the composition of the substrate. Virus is active within the limits of temperature already known for other organisms, and its inactivation by chemicals presents no feature not already familiar to the biologist.

One corollary from the living nature of the virus is somewhat difficult of elucidation; if virus was the first form of life, it ought to be possible to find prototrophic viruses which feed on inorganic materials. Those known at present are entirely parasitic, but the detection of prototrophic viruses presents so many difficulties that they are not likely to be discovered until research comes to be organized with an intensity comparable to the present war effort.

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THE AIR-DRIVEN ULTRACENTRIFUGE

By Dr. F. R. Eirich and Prof. E. K. Rideal, M.B.E., F.R.S.,

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SEDIMENTATION and diffusion constants of macromolecules are conveniently determined with the oil-driven ultracentrifuge of the Svedberg type. Such machines are not generally available for normal routine laboratory work, and in a search for an apparatus which was at the same time simple to run, economic to install but also precise in operation, our attention naturally turned to the air-driven top of Henriot and Huguenard, which has been developed so well in the United States by Beams, McBain and especially by the Sharples Centrifuge Company of Philadelphia.

Whilst machines of this type have frequently been used for purposes of separation and determination of approximate mass weights, it seemed worth while to examine how far it could be made an instrument of precision.

After a visit to Philadelphia, an experimental model was kindly constructed for us by the Sharples Co. The driving mechanism is of the turret-type[1], and spins a round rotor (8·85 cm. diameter) in an atmosphere of hydrogen. The air pressure necessary to lift the rotor is 5¼ lb./sq. in., and 20 lb./sq. in. air pressure on the driving jets produces a speed of about 75,000 r.p.m. at 15 mm. hydrogen pressure. The bursting risk limits the speed to 105,000 r.p.m. (fields of 372,000 g in the cell), but in the interests of safety speeds exceeding 85,000 r.p.m. (245,000 g) are rarely used, allowing molecular weights of about 15,000 (cytochrome C) to be determined.

The solutions to be examined are contained in transparent cells differing but little from those used by Svedberg[2]. The cells are sectorial in shape, 10 mm. high, 2 mm. deep with a radial angle of 5°; the depth, which influences the working concentrations, has since been increased to 5 mm., and recently a modification of the original design has

enabled cells 10 mm. deep to be used. The weights of these cells are adjusted to 0·001 gm. and the position of the centre of gravity (height above bottom plate) to 0·1 cm., thus reducing the stresses in the rotor.

The speed of the rotor is measured by amplifying an alternating current to drive a synchronous motor. The current is generated by a small brass disk, containing an iron segment, which is fixed to the top of the rotor shaft and rotates in a magnetic field. The general scheme is as illustrated (Fig. 1).

It has been stated that this or a similar method of speed measurement has been applied in the Laboratory of Physical Chemistry, Uppsala, and was criticized[3] for not functioning reliably at speeds above 90,000 r.p.m. Our own experience is that it is entirely satisfactory and preferable to all stroboscopic methods. The highest operating speed used on this ultracentrifuge has been 91,700 r.p.m., and the speed indicated was checked by plotting the driving air pressure at lower speeds and extrapolating to 91,700 ; no large error was observed. The inaccuracy can be made of the order 0·1 per cent with practice as it only entails stop-watching a mark past an index. The reduction gear is such that each revolution of the mark per minute corresponds to 10,000 r.p.m. of the rotor. A rough evaluation of the speed is obtained from the current output of the generator.

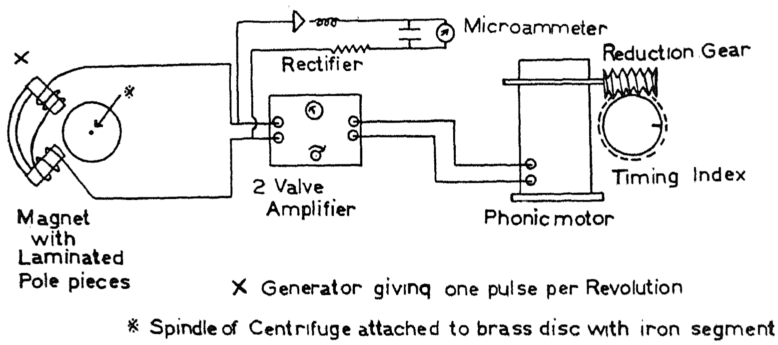

Fig. 1.

Revolution counter : schematic diagram

After preliminary examination of several methods of optical examination, including that of Lamm, we finally decided to make observation of the sedimenting boundary by the Philpot *Schlieren* method[4]. The optical bench, some 2·8 m. long, was erected on concrete pillars and isolated from the rest of the basement floor. The centrifuge, likewise mounted on a concrete table, ran perfectly smoothly without any vibration, even when the air compressor (Ingersoll-Rand) was in operation. The diagrams first obtained (2 per cent solutions in the cell) were good, but when the resolving power was increased by magnification (0·1 per cent solutions in the cell), the diagrams were crossed by innumerable dark lines which hazed the outline of the sedimenting 'peak'. These lines were eventually traced to refractive index gradients in the material of the lenses and plates. The two fused quartz plates which admit the light beam into the centrifuge housing were found to be particularly bad, so these were removed and replaced by the two *Schlieren* lenses. Many of the dark lines were due to dust particles on the lenses and edges, so these are now kept clean. The lamp used is a Philips tungsten ribbon lamp (100 w. 6 v.) and the intensity is such that exposures are only one tenth as long as those required with the mercury lamp previously used.

At the present time there is some uncertainty as to the temperature of the rotor ; the rotor spins in hydrogen at *ca.* 10 mm. pressure in a chamber through the walls of which is circulated thermostated water. It was assumed in the preliminary runs that the rotor is at the temperature of the walls ; this, however, is probably not the case and a method for determining the exact temperature is being evolved.

Up to the present time, only sedimentation velocity measurements have been made, but it is hoped before long to include sedimentation equilibrium determinations. In addition to the sedimentation constant the diffusion constant of the solute must be known. A value for the diffusion constant can be obtained[5] from the sedimentation by applying Weiner's[6] development of Fick's law.

The experimental results described below were carried out more with the idea of developing technique than measuring molecular weights, but the results are sufficiently interesting to warrant description. When considering these results, it should be remembered that the sedimentation constant S_{20} is calculated assuming that the temperature in the cell is the same as the walls of the chamber. The materials centrifuged were several proteins.

Ovalbumin. A sample of ovalbumin was subjected to analysis to determine whether the instrument was functioning satisfactorily ; the results are given in Table 1, together with data[7] obtained

Table 1. Ovalbumin.

Solution, 0·75 per cent ovalbumin in 0·2 M sodium chloride. $T = 25°$ C. pH 8·0.

	Air driven	Oil driven (Uppsala)
Sedimentation constant, S_{20}	$3{\cdot}75 \times 10^{-13}$ cm./sec.	$3{\cdot}55 \times 10^{-13}$ cm./sec.
Diffusion constant, D_{20}	$7{\cdot}6 \times 10^{-7}$ cm./sec.	$7{\cdot}76 \times 10^{-7}$ cm./sec.
Molecular weight	49,000	43,800

(*Continued on page 551.*)

NATURE

SUPPLEMENT

Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704

SHORT REVIEWS

Vital Religion

A Brotherhood of Faith. By Sir Francis Younghusband. Pp. ix+101. (London: John Murray, 1940.) 3*s*. 6*d*. net.

SIR FRANCIS YOUNGHUSBAND relates that, at the end of his successful mission to Tibet thirty-four years ago, to negotiate a treaty of commerce and intercourse, he went alone to the mountain-side with the feeling of peace on earth and goodwill among men filling his mind and heart. It was there and then that he became exalted with emotion like that experienced in evangelical conversions, and to which modern psychology is inclined to refer all religious convictions. From that time he has in several books, and in the organization of World Congresses of Faiths, been delivering the message of fellowship among men of all high religious beliefs.

In this small book Sir Francis brings together eight addresses given by him on this theme. The spiritual and ethical elements in the great religions of the world should unite people of many countries in the common cause of truth and righteousness. A World Commonwealth may be a dream, but the federation of faiths is one way of approaching it, and the movement of which Sir Francis is an inspired apostle is towards that high destiny of mankind.

The Soul of the Universe

By Gustaf Strömberg. Pp. xviii+244. (Philadelphia: David McKay Company, 1940.) 2 dollars.

THIS book contains a clear and well-written statement of some recent developments in physical and biological theory. Combined with this is a speculative cosmology based on the hypothesis of a world-soul. This is worked out in some detail with considerable ingenuity, specially in its biological and psychological implications. Unfortunately the working out requires subsidiary *ad hoc* hypotheses of the kind that enable any theory to be fitted to any facts. It must be said in favour of the author that his account is plain and straightforward and free of the mystifications and paradoxes used by certain contemporary popularizers. The book may appeal to the general public on its merits. It is scarcely likely to interest the man of science, and the philosopher who is concerned with the notion of the world-soul will probably prefer Plato's "Timæus", even though the physical theory is out of date.

Chemicals of Commerce

By Dr. Foster Dee Snell and Dr. Cornelia T. Snell. Pp. viii+542. (London: Chapman and Hall, Ltd., 1940.) 28*s*. net.

AS chemicals enter more and more into commerce there arises the need among those who have to deal with them for a minimum of information giving at least the salient facts. Chemical dictionaries tend to become too long and are expected to be more or less complete to be of service. The authors have made a selection of substances of trade importance and give more or less information about them in paragraphs grouped into chapters under appropriate headings. The chemical composition, but not the structural formulæ, of the substances is indicated. For each product there is in general given a short description, method of manufacture, common impurities, commercial grades and uses.

The book is primarily intended for American consumption, where they are more chemically minded than in Great Britain, by people without formal chemical training. The wide experience of the authors as consultants makes it probable that the selection is sound and the information reliable; the venture deserves success as a means of spreading accurate chemical knowledge.

Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests. Pp. iv+149. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s*. net.

THIS second volume of the treatise on electrochemistry and electrochemical analysis deals with gravimetric electrolytic analysis, including internal electrolytic analysis (in which the electro-

lysing current is generated in the deposition cell itself by anodes of baser metal separated from the test solution by a diaphragm), electrolytic micro-analytical methods and the electrolytic Marsh test as applied to arsenic, antimony and germanium. Particular attention is given to methods of separation by control of the cathodic potential with the aid of an auxiliary electrode. The treatment is essentially practical, the first chapter dealing fully with apparatus, the second with technique and the remaining six chapters with special determinations and separations. Industrial applications, such as alloy analysis, are adequately covered.

Since many of the methods have been developed or perfected by the author, the treatment is based on sound practical experience, and the many small details which are essential for success are satisfactorily presented. The compositions of the solutions, for example, are given, together with the electrolysing currents and voltages and the method of treatment of the deposit for weighing if this is necessary.

The book is a valuable contribution to the literature of analytical chemistry and should find a place in every laboratory. A third volume dealing with volumetric methods, capacitance measurements and *p*H determination is planned.

Elementary Crystallography

By Dr. John W. Evans and George M. Davies. Second edition. Pp. vii+149. (London: Thomas Murby and Co., 1940.) 6*s*. 6*d*. net.

THIS well-established text-book has served some generations of students faithfully and continuously. It now re-appears in its traditional form, but with the addition of a particularly clear account of X-ray crystallography, accompanied by illustrations from the work of Mrs. G. M. Davies.

This new section follows the usual lines: the important point is that readers of this second edition will have before them an adequate introduction to modern methods, alongside the classical treatment.

Aids to Physical Chemistry

By R. G. Austin. Pp. x+361. (London: Baillière, Tindall and Cox, 1940.) 5*s*.

THIS little manual is a valuable member of the "Students' Aid Series". All the usual branches of physical chemistry are represented, and the information is at once concise and adequate. Perhaps it is well to stress that the booklet is not intended to be a substitute for text-books; to use it for such a purpose would be a great mistake. Its purpose is to facilitate reference by those already conversant with the subject. There are many numerical examples, worked out in full.

Hydrocarbon Chemistry

A General Discussion held by the Faraday Society, April 1939. Pp. ii+805–1092. (London and Edinburgh: Gurney and Jackson, 1939.) 12*s*. 6*d*. net.

THIS volume comprises the papers presented at one of the Faraday Society's well-known discussions, that on hydrocarbons held in London a few months before the outbreak of war. It fully maintains the standard expected of those deliberations. Part 1 deals with homogeneous thermal reactions, Part 2 with catalysis, Part 3 with synthesis and transformations, and Part 4 with olefine polymerization. The introduction is contributed by Prof. E. K. Rideal.

The subject is of great importance to-day, in view of increased piston speeds in many engineering problems, and the insatiable demand for higher pressures in bearings. Again, new chemical industries are likely to look upon hydrocarbons more and more as a source of raw materials.

Some theoretical work of great interest upon structural and energy problems is presented by Lennard-Jones and Coulson, and a critical review of the pair theory of mesomerism by Lloyd and Penney. Hydrogenation of coal and lignite is discussed as a large-scale example in Part 3. As usual, much detail is brought out by individual speakers on their special aspects of the general theme.

Colloid Chemistry (A Textbook)

By Prof. Harold Boyer Weiser. Pp. viii+428. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s*. net.

THIS text-book, by the author of the well-known "Inorganic Colloid Chemistry" in three volumes, is intended for students who have an elementary knowledge of physical chemistry, and is planned to acquaint the student with the foundations of colloid chemistry, to formulate systematically and to correlate critically the theories underlying colloid chemical behaviour, and to illustrate the wide applications of the subject in the fields of the industrial arts, agriculture and biology. After a brief introduction on general principles, there are seven chapters on adsorption at various types of surfaces, ten chapters on the preparation and properties of lyophobic and lyophilic sols, two shorter sections on gels, emulsions and foams and aerosols and solid sols, respectively, and finally two chapters on the applications of colloid chemistry to contact catalysis, dyeing and clay. Numerous useful references are given, many of them to technical as well as scientific journals.

The treatment is on the whole descriptive and experimental rather than theoretical and mathematical, although many important equations are deduced and the section on Brownian movement gives a simplified derivation of the Einstein equation. There are many tables of numerical data, and the quantitative side of the subject is well cared for. Historical developments add interest to many sections, and the older classical work of Graham, Linder and Picton, Freundlich, Ostwald, and others receives proper recognition alongside the newer developments of the subject. In this way a well-balanced treatment is achieved, and the misleading idea that the subject is of very recent growth is corrected. A critical treatment of the results and theories (for example, of the so-called activated adsorption) is a valuable feature. Modern work is well represented, and a concise yet clear style has made it possible to give a

very large amount of interesting information in a small compass.

The reader never feels that the treatment is sketchy, and the student who assimilates the contents of the book will have laid a solid foundation for further study of special fields of colloid chemistry. There are more than a hundred good illustrations.

Chemical Calculations

By J. S. Long and H. V. Anderson. (International Chemical Series.) Fourth edition. Pp. xii+266. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 11*s.* 6*d.*

THE fact that this book has reached a fourth edition in six years indicates that it has achieved popularity, and the contents show that it provides a very sound and interesting course of exercises. Each section has an introductory outline and a brief statement of the underlying theory, and much of the material here presented is supplementary to that found in text-books. The examples for exercise are numerous, well-chosen and in very many cases provided with answers. Although it is stated that answers are "purposely omitted" in come collections of problems, it is not clear that this has any advantage, and these might well be provided in future editions.

The usual topics in an elementary course are well covered and special mention must be made of the chapters on gas analysis, oxidation and reduction, and those parts of physical chemistry which are of importance in chemical analysis (mass action and solubility product). In the sections on ionic equilibrium the limitations to weak electrolytes are not emphasized, and in calculations involving strong electrolytes the fact that complete ionization is assumed and that the simple law of mass action should not be applied to them is not clearly stated. There is no reason why this should not be done even in an elementary course, and these chapters might well be supplemented and revised in future editions.

The intention of the authors to fit the student to encounter the actualities of chemistry is wholly praiseworthy, and it has been very ably implemented in the book. As they say: "chemical calculations serve to develop in the student aptitude in the application of various principles of chemistry under actual working conditions", and since the book can be covered in fifteen weekly periods in the first year, this valuable training should not encroach unduly on other parts of the course.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 27: Magnesium. Teil B, Lief 4: Schluss der Verbingungen, Technische Darstellung der Magnesiumverbindungen. Pp. 423–550+xx+xviii. (Berlin: Verlag Chemie, G.m.b.H., 1939.) 18.75 gold marks.

THE present part of "Gmelins Handbuch" covers compounds of magnesium with the alkali metals and ammonium and beryllium, and describes technical methods of manufacturing the oxide, hydroxide, carbonate, chloride and sulphate of the metal. Magnesium oxide and hydroxide are manufactured chiefly from magnesite, although numerous processes have been adopted for utilizing dolomite. The temperature at which the oxide sinters is very high, but can be lowered appreciably by the addition of ferric oxide. The hot material is sprinkled with water to hydrate any calcined limestone, dolomite or caustic magnesia, which react much more easily than sintered magnesia to form a dust which is easily separated.

Much work has been done on the preparation of anhydrous magnesium chloride for the electrolytic extraction of the metal. As is well known, dehydration of the hexahydrate is accompanied by hydrolysis, so that the salt has to be heated in the presence of hydrogen chloride, which causes rapid corrosion of the vessels from 325° C. upwards, but it has been found possible to raise the temperature to 450° C. and thereby greatly accelerate dehydration by rigorously excluding air. Other methods used for dehydration of the chloride involve either electrolytic decomposition of the water alone, or the formation at low temperatures of a hexamine which can be dried at 300° C., or the conversion of the oxide direct to chloride.

Introduction to Carbohydrate Biochemistry

By Dr. D. J. Bell. Pp. viii+112. (London: University Tutorial Press, Ltd., 1940.) 3*s.* 6*d.*

NO class of organic compounds surpasses the carbohydrates in interest. Sir Frederick Hopkins speaks of the intellectual thrills induced by the progress of the work of Emil Fischer in particular: since then the development has been to some extent in Great Britain. Almost every worker in biochemistry, using the term in its widest significance, has to know something about the sugars and to master their structural formulæ. It is for these that the present book is provided, and its ordered assembly of formulæ drawn and printed with praiseworthy clarity will go far to make what is in reality difficult appear easy.

The subject-matter is highly concentrated, but the author has the knack of putting the essentials into the fewest words. After describing the sugars themselves he discusses the liberation of energy during fermentation, metabolism in muscle, uronic acids, glycosides, nucleotides in particular. Sufficient references are given to the literature.

The book forms a notable contribution to any library which no biochemist can be without.

Principles of Animal Biology

By Prof. Lancelot Hogben. Second edition, revised. Pp. 415. (London: George Allen and Unwin, Ltd., 1940.) 7*s.* 6*d.* net.

PROF. HOGBEN'S text-book on animal biology was first published in 1930 and later went out of print. The present edition planned on the same lines as the original, although the pattern has been improved by the adequate revision of the whole book

and the complete rewriting of certain chapters. This applies particularly to the chapter on fossil veterbrate skeletons, which has been extended and remoulded in order to include references to the many new discoveries of the past ten years. An advantageous innovation in this edition is that the combination of author Hogben with artist Horrabin, which was so successful in the preparation of "Science for the Citizen" and "Mathematics for the Million", has again been used. Mr. Horrabin has redrawn each illustration and has added many new ones, in which diagrammatic clarity is constantly emphasized, although never at the expense of artistic refinement.

Prof. Hogben remarks in the preface that this work is not intended to supplant dissecting manuals or formal text-books; it has been prepared solely as a supplementary reader to the more rigid lecture courses in animal biology taken by candidates of Higher Schools and first-year university standard, emphasis throughout being placed on function rather than on structure. *Homo sapiens* receives attention strictly on his merits as a vertebrate animal, although one might have hoped that the author had dipped his pen in a less restraining fluid. A general criticism of the book is that Prof. Hogben frequently overestimates the sum total of factual information possessed by university students after a one-year course in zoology. This is particularly evident in the chapter dealing with the principle of succession with special reference to the vertebrate skeleton. The new edition is a useful addition to the current stock of literature, however, and should establish itself as quickly and successfully as its predecessor. As one would expect in a second edition, the book is free from even minor inaccuracies.

Silviculture of the Trees of Trinidad and Tobago, British West Indies

By R. C. Marshall. Pp. xlvii+248+16 plates. (London: Oxford University Press, 1939.) 21*s*. net.

IN this book the author summarizes, from a sylvicultural point of view, the results of eleven years work, during which he was in charge of the Forest Department of Trinidad and Tobago. The first part of the book consists of an account of the physiography and vegetation of the two islands, condensed from the author's previous publication (*Oxford Forestry Memoirs*, No. 17; 1934).

In a brief discussion of the sylviculture of the tropical high forest which follows, the author urges the advisability of so conducting regeneration operations as to produce a forest resembling the natural type, especially in structure, though with a higher proportion of valuable species. In these forests the number of such valuable species is small; they are found usually in the dominant class and there is a tendency to confine attention to them. The importance of the sub-dominant and understory constituents for the maintenance of the health and well-being of the forest must be recognized though it is not fully understood. "The question at issue is to what extent the very complex natural vegetation can be simplified without impairing the properties that enable it to persist healthily as a vegetative type, self-supporting and permanent."

The bulk of the book consists of descriptions of the trees of the islands, arranged in families as in a Flora, under some or all of the following heads: name, botanical and vernacular, general description of the tree, distribution and habitat, botanical, germination, seedling, sylvicultural characteristics, regeneration, utilization. The botanical descriptions are nearly all from field examinations of fresh material. Twenty-eight excellent line drawings by Mrs. Marshall supplement the botanical descriptions of the more important species.

Laboratory Studies in Zoology

By Dr. H. D. Reed and Prof. B. P. Young. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xii+207. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 9*s*.

THIS is the second edition of the manual used by beginners in zoology at Cornell University. The frog is dissected in some detail to illustrate bodily structure in a vertebrate, followed by a study of the usual invertebrate types, Amphioxus and a freshwater fish. The only mammalian material is the eye, though it is suggested that at the end of the course an opportunity should be given for an investigation of the fœtal pig. The simple tissues are dealt with very briefly. Practical studies in mitosis, gametogenesis and heredity are a welcome addition to the first-year course, and are rarely attempted in Great Britain. In embryology the student sees the early developmental stages of the starfish and all the stages in the life-history of the frog. A study of mixed protozoan cultures provides training also in the use of a key for the identification of common species.

Directions and descriptions are clearly expressed, and questions at the end of each chapter suggest problems for the student to elucidate for himself. The production of the book is excellent.

Anatomy of the Sheep's Brain

A Laboratory Atlas for Students of Zoology. By Prof. E. A. Briggs. Pp. xiii+50+8 plates. (Sydney: Angus and Robertson, Ltd., 1939.) 6*s*.

THIS small book contains a useful elementary account of the structure of the sheep's brain intended, as its sub-title suggests, for first-year students of zoology. The brain of the sheep from its size, and the ease with which it can be obtained and handled affords a much better object for study than the brains of the smaller mammals generally employed for dissection in this course. The detail given is well suited for first-year zoology, but the medical student would also find it helpful to work through it as a revision exercise before passing on to the detailed study of the more complex human brain. The text is written in a clear and straightforward manner, and the well-produced illustrations add considerably to its usefulness.

Notter and Firth's Hygiene
Revised by L. C. Adam and E. J. Boome. Tenth edition. Pp. x+518+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 12*s.* 6*d.* net.

SINCE the last edition of this well-known work which appeared in 1921, so much advance has been made in the domain of hygiene that the present editors, who are assistant medical officers in the Public Health Department of the London County Council, have found it necessary to make numerous additions and deletions to bring the book up to date. The principal additions which have been made in the present volume are the descriptions of the Public Health Act of 1936, the Housing Act of 1936, the Factories Act of 1937 and the Food and Drugs Act of 1938. The sections on diet, school hygiene, maternity and child welfare, speech defects, infectious diseases and mental deficiency have also undergone revision. The work, like previous editions, will form a valuable guide to those seeking information on the various departments of public health.

Mental Disorders in Modern Life
An Outline of Hopeful Treatment. By Dr. Isabel Emslie Hutton. Pp. xiii+204. (London: William Heinemann (Medical Books), Ltd., 1940.) 3*s.* 6*d.* net.

THIS little work, which is based on many years experience of mental diseases not only in Great Britain but also on the Continent and in America, is primarily intended for non-medical readers, especially magistrates, coroners and social workers, but it will also prove a useful introduction to the study of psychiatry, particularly in its practical aspects, by the medical student and graduate. In spite of its subtitle the book is not confined to treatment but also contains a concise and lucid account of the history, causes, symptoms and legal aspects of the various forms of mental disease. Special chapters are devoted to the discussion of mental deficiency, sterilization and research. In the last chapter Dr. Hutton maintains that the most important development of the future lies in the out-patient clinic, where all who feel mentally ill can openly come for treatment.

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(*Continued from page 542.*)

by the Uppsala school. The agreement between the two series is fair, especially as the temperature is doubtful.

Cytochrome C. This protein was centrifuged in order to determine the lower limit of molecular weights resolvable. The sedimentation constant S_{20} 2·1 $\times$ 10^{-13} cm./sec. for a 0·7 per cent solution in phosphate buffer at *p*H 7·3 agrees well with that obtained by Anderson and Pederson[8] (S_{20}, 1·9 $\times$ 10^{-13}).

A globulin arachin from the ground nut (*Arachis hypogaea*). Preliminary runs on this protein indicate the existence of five different groups of molecular weights dependent on the nature of the salt used to effect solution.

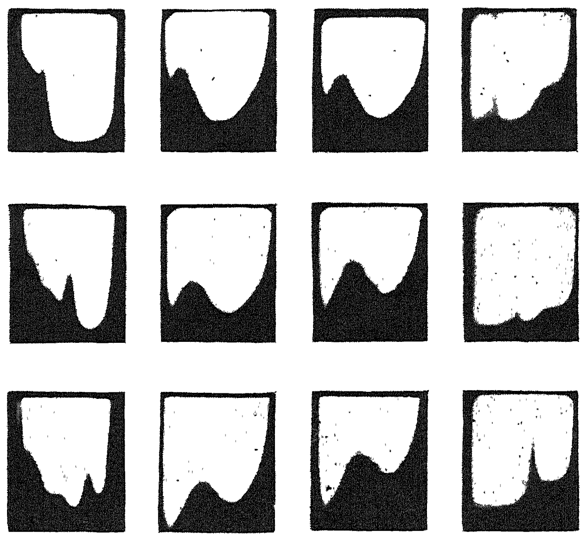
The sedimentation constant, diffusion constant and molecular weight are tabulated below (Table 2) together with the shape factor, which indicates an increasing globular shape with decrease in molecular weight.

Table 2. Arachin.

Group	S_{20}	D_{20}	Mol. Wt.	Shape factor
I	13·8 $\times$ 10^{-13}	2·0 $\times$ 10^{-7}	600,000	1·92
II	11·2	2·4	400,000	1·84
III	7·4	5·0	140,000	1·30
IV	3·25	10·0	30,000	1·05
V	1·75	9·3	20,000	1·21

These fractions of differing molecular weights were obtained by treating the protein with lyotropic salts; different salts either extracted different preformed globulins or effected different decompositions of one globulin, but no salt produced a diagram showing all five groups; dilute ammonia solutions revealed the presence of groups II, III, and V in the extract. The diagrams for ammonia are reproduced (Fig. 2 *a*). During solubility tests of the protein in lyotropic solvents, it was found that the salts fell into three groups. It is interesting to note that the presence or absence of some of the five groups places the sedimentation diagrams into the same three classes.

Carbonic Anhydrase. Prof. D. Keilin kindly provided us with a sample of carbonic anhydrase which had been centrifuged by Dr. Philpot at Oxford (unpublished result), but in no way did the two diagrams resemble one another. The diagram obtained by Dr. Philpot was typical of that obtained with a fibrous protein, with a sedimentation constant of about $S_{20} = 3 \times 10^{-13}$. The diagram (Fig. 2 *b*) obtained with the fresh sample was very much like a globular protein with a sedimentation constant of S_{25} 3·80 $\times$ 10^{-13}. This first sample had been prepared using neutral salts as precipitants, so a further sample prepared by acetone precipitation was obtained; here again the diagram (Fig. 2 *c*) was similar to that of a globular protein with a sedimentation constant of $S_{25} = 3{\cdot}90 \times 10^{-13}$. Finally, it was suspected that perhaps some acetone had been retained by the sample sent to Dr. Philpot; a solution of carbonic anhydrase in a 14·3 per cent acetone solution was analysed. This time the diagram (Fig. 2 *d*) is exactly similar to that obtained by Dr. Philpot, the sedimentation constant being $S_{25} = 3{\cdot}20 \times 10^{-13}$. The diagram is typical of a fibrous protein and agrees with Dr. Philpot's to the extent of having the same minor 'peak' near the bottom of the cell which does not appear to move at all during the run. Though the amount of acetone is high there seems little doubt, in view of the identity of diagrams, that this is the reason for the anomaly



(*a*) (*b*) (*c*) (*d*)

Direction of sedimentation, ⟶.

Fig. 2.

Sedimentation diagrams. (*a*) Globulin fraction in $N/10$ ammonia; (*b*) carbonic anhydrase salt precipitation; (*c*) carbonic anhydrase acetone precipitation; (*d*) carbonic anhydrase in 14·3 per cent acetone solution.

shown by the early centrifuge diagrams. Table 3 shows a summary of the data on carbonic anhydrase.

Table 3.

	Run 72	Run 73	Run 76
Substance	0·6% carbonic anhydrase	0·6% carbonic anhydrase ppt. by acetone + acetone dialysed	0·6% carbonic anhydrase acetone prep.
Solvent	0·2 *M* NaCl	0·2 *M* NaCl	14·3% acetone 86·7% 0·2 *M* NaCl
Gravitational force	222,000	220,000	240,000
Sedimentation constant $\times$ 10^{-13} 25° C.	3·80	3·90	3·20 $\times$ 10^{-13}

It should be mentioned that the diagrams shown have not been corrected for the reference diagrams, which have been omitted.

We have to thank Mr. R. P. Sinclair for considerable assistance. Our thanks are also due to Dr. Philpot for many discussions, to the Sharples Centrifuge Co., the Royal Society and Imperial Chemical Industries, Ltd., for financial and technical assistance.

Owing to the present international situation, it has not proved possible to obtain the collaboration of my co-worker, Dr. F. R. Eirich, in writing this brief survey of work on the air-driven ultra-centrifuge. Whilst he might not agree in detail with some of the observations made therein, he expressed an earnest desire for these results to be communicated as soon as was conveniently possible.—E. K. R.

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OBITUARIES

Prof. R. T. Hewlett

Richard Tanner Hewlett, a well-known and highly respected figure in British bacteriology for some forty-five years, died on September 10 at the age of seventy-five. Educated at King's College School and trained for his professional career at the King's College School of Medicine, Hewlett graduated M.B. Lond. in 1890 and for three years acted as demonstrator in bacteriology, eventually in 1901 succeeding to the chair of bacteriology vacated by his chief, Prof. Edgar Crookshank. In the interval he had served (1894–1901) on the bacteriological staff of the British Institute of Preventive Medicine under its then director, Dr. Allan Macfadyen. During his career he also acted as director of pathology and later as consulting pathologist at the Seamen's Hospital, and for many years he lectured on bacteriology at the London School of Tropical Medicine.

Hewlett's interests lay almost entirely in the application of bacteriology to hygiene and public health, and numerous articles from his pen on a diversity of subjects—water pollution, shell-fish and sewage contamination, pure milk supplies, cellular contents of milk, insect carriers of disease, etc.—will be found in the appropriate journals from 1897 onwards. He was particularly interested in the disinfection process and in methods of testing disinfectants, to which subject he devoted his Milroy Lectures before the Royal College of Physicians in 1909. In these lectures he expressed the view that the similarity of certain disinfection curves to that of a monomolecular reaction was only apparent, and that the course of disinfection processes generally was most probably to be accounted for by the assumption of a variation of resistance existing among the individuals in the bacillary population exposed—a view which has since been widely ventilated and experimentally tested.

At the British Institute of Preventive Medicine, Hewlett had been greatly intrigued by the experiments of Macfadyen and Rowland on the extraction of cell juices from yeasts and bacteria by grinding at the temperature of liquid air. Later, with the help of his former colleague Mr. J. E. Barnard, an improved grinding apparatus was devised, and the results obtained by immunization of animals with such juices (endotoxins) were communicated to the Royal Society in 1909 and 1911. Assay of this work, which unfortunately was not carried far enough or conducted on a sufficiently large scale, is difficult even now; but it still has its interest for workers occupied with the more detailed analysis of bacterial antigens on modern chemical and serological lines.

Hewlett was widely read in his subject and wrote with ease. His student text-books on "General and Special Pathology" and on "Applied Bacteriology" have had a large vogue for many years. To the "System of Bacteriology" he contributed important articles, and the columns of Nature contain many contributions from his pen. In recent years he took a great interest in the work of the Royal Microscopical Society, of which he was honorary secretary at his death. Unassuming and ever helpful and friendly in his human relations, Hewlett leaves a pleasant memory, and the undersigned records with gratitude the interest he maintained in the work and affairs of the Lister Institute, where he served an apprenticeship in the 'nineties. To his widow and family our sincere sympathy is extended.

J. C. G. Ledingham.

Prof. H. Stroud

Henry Stroud was born at Bristol on August 7, 1861. He began his education at Bristol Grammar School and proceeded with an entrance scholarship in 1879 to the University College in that city, where he came under the influence of Silvanus Thompson. In 1880 he was awarded the Gilchrist Scholarship tenable at Owens College, Manchester, where he studied under Balfour Stewart and Henry Roscoe for two years, at the end of which period he apparently scooped up all the mathematical and physical scholarships in his immediate neighbourhood and went with them to St. John's College, Cambridge. In the

Mathematical Tripos list for 1885 he was eighth Wrangler. In 1886 he obtained a first class in physics in Part II of the Natural Sciences Tripos, and in the same year graduated as doctor of science in the University of London.

Stroud was appointed lecturer in physics at the College of Physical Science (which later became Armstrong College and is now King's College), Newcastle-upon-Tyne, in 1886 and was elected professor a year later. In the following years he became a strong believer in the value of popular scientific lectures, and many will remember his numerous experimentally illustrated lectures given in towns and villages throughout the northern counties of England on X-rays, radium and wireless telegraphy at a time when these subjects were in their infancy. He played an important part in the development of the institution as a self-contained university college and as a unit of the University of Durham.

For several years Stroud was associated with the late Lord Armstrong in his researches on "Electric Movements in Air and Water". Although he published little himself, he was always keenly interested in research and he endowed various college prizes with a view to its encouragement. On his retirement in 1926, after forty strenuous sessions in harness, he was elected professor emeritus by a college grateful for his valuable services. Stroud died in peaceful seclusion at Gerrard's Cross on September 3.

George W. Todd.

Colonel H. L. Crosthwait, C.I.E.

Herbert Leland Crosthwait, who died on September 11, aged seventy-two, was the eldest son of the late Mr. Samuel Crosthwait, of The Lodge, Bagenalstown, County Carlow, Ireland, and educated at Rossall and at Trinity College, Dublin. He entered the Royal Engineers in 1890. Two years later he went to India and in 1897 he joined the Survey of India, in which he remained for the rest of his service. Here he soon became well known for his very extended knowledge of a variety of scientific subjects; in fact, if he had concentrated on any one subject he would easily have been one of the authorities on that subject. His wide knowledge and experience, however, made him a most delightful companion. He could talk well and easily and with full knowledge on many topics.

As a surveyor, Crosthwait was mostly employed on the scientific side, but quite easily switched on to the topographical branch when required, as, for example, when employed on the Chile-Argentine Boundary Commission, or during the War of 1914–18 in East Persia, and during the Waziristan Expedition and Third Afghan War of 1919–20. For these services he was awarded a C.I.E.

On his retirement Crosthwait began to specialize on the subject of air surveys and became a director of the Aircraft Operating Company, Ltd., where his knowledge of topography and his very quickly acquired knowledge of the application of air photography to map-making made him a much valued colleague. He was on the council of the Royal Geographical Society for many years, where his appreciation of the value of air photography to map-making made him a most useful member; it might, in fact, be fairly said that no one rendered better service to cartography of late years than Crosthwait did in leading air survey on the right lines; that is, to a full but not excessive appreciation of its value.

Added to his wide knowledge over an extensive range of subjects, Crosthwait had a great charm of manner, and a very human kindliness which made him a valued companion, whether in the wilds of the jungle or at a civilized meeting of the members of a scientific society. His death will leave a wide gap among his large circle of friends.

C. H. D. Ryder.

Lieut. J. H. Martin, R.N.V.R.

Lieut. James Martin, who has been reported lost at sea, had an unusual career compared with other polar explorers of the last twenty years. His whole interest was the sea, and his contributions to Antarctic discovery depended on his intimate knowledge of seamanship and his devotion to shipwork. He broke away from office work in the City to serve before the mast in the sailing ship *Garthpool*, and some years later he signed on as a seaman in the *Discovery* on a summer voyage to the Antarctic in 1929–30 under Sir Douglas Mawson. Martin shipped on her again in the following season and was ranked as boatswain. In order to improve his knowledge of ice navigation he then went to Norway for spring sealing in the White Sea and served as a seaman in the *Quest*. Soon afterwards he was chosen as leader of the 1933 Oxford University Expedition to Spitsbergen, but was prevented in the end from actually taking part owing to having been severely frostbitten whilst sledging in Northern Canada.

Martin made plans for an Antarctic expedition, but set them aside in favour of John Rymill's British Graham Land Expedition. He accordingly volunteered as one of Rymill's crew and was appointed mate in the *Penola* commanded by Lieut. R. E. D. Ryder, R.N. Much of the ship work was done under sail, in which Martin was an expert. Great size and strength, fearlessness and gentleness went to the make up of this remarkable man. Ryder has made clear how much he depended on his mate during the three years voyage, and the success of the expedition was in part due to the way these two understood each other, and worked the ship in narrow waters. When war broke out, Martin transferred to the Navy from the Grenadier Guards, in which he had held a commission in 1918, and from then for most of the time was shipmate once again with Ryder.

J. M. Wordie.

We regret to announce the death of Mr. J. B. Beresford, C.B.E., formerly secretary of the University Grants Committee, and of the Standing Committee on Museums and Galleries, as a result of enemy action, aged sixty-two.

NEWS AND VIEWS

Lieut.-Colonel J. T. C. Moore-Brabazon, M.P.

The announcement on October 3 of the appointment of Lieut.-Colonel J. T. C. Moore-Brabazon to be Minister of Transport has been received with satisfaction by men of science. He is well known as a pioneer in motoring and aviation, and holds No. 1 certificate granted by the Royal Aero Club for pilots. Throughout his career he has brought scientific principles to bear on his work and expressions of opinion, and for this reason alone readers of Nature will be gratified to learn of his appointment to such a ministry rendered all the more important during the present situation. Those who know Lieut.-Colonel Moore-Brabazon personally will feel even more satisfied in that the position is now being filled by a man of courage and determination. He was formerly connected with the Ministry of Transport as parliamentary secretary during two periods covering the years 1923–27. He is, at present, member of Parliament for Wallasey.

James Watt International Medal

The council of the Institution of Mechanical Engineers has unanimously decided to award the James Watt International Medal to Prof. Aurel Stodola, of Zurich, on the recommendation of the Engineering Institute of Canada, the Czechoslovak Society of Engineers, and the Swiss Society of Engineers and Architects. The Medal was founded by the Institution in 1936 to commemorate the bicentenary of the birth of James Watt on January 19, 1736, and is awarded every two years to an engineer of any nationality who is deemed worthy of the highest award that the Institution can bestow and that a mechanical engineer can receive. In making the award the Institution has secured the co-operation of engineering institutions and societies in all parts of the world. The Medal is given for world-wide eminence in mechanical engineering in any direction, science or research, invention or production.

Mr. N. W. Pirie

The Committee of Management of the Rothamsted Experimental Station has appointed Mr. N. W. Pirie as head of the Biochemical Section of the Station. Mr. Pirie was an exhibitioner of Emmanuel College, Cambridge, and after gaining first classes in both parts of the Natural Sciences Tripos was awarded a research studentship under Sir Frederick Gowland Hopkins in the School of Biochemistry, where later he was appointed Rockefeller demonstrator. He also gained a Rockefeller Travelling Fellowship to visit California to study certain virus disease problems, but this was interrupted by the War. At Rothamsted he will be primarily concerned with the virus diseases of crops, which at present cause great and increasing losses and for which no remedies are known. He has already, in conjunction with Mr. F. C. Bawden of Rothamsted, made important and promising investigations on this subject, and has succeeded in isolating the actual viruses causing some of the diseases.

Retirement of Dr. W. E. Collinge

During the twenty years of his keepership of the Yorkshire Philosophical Society's Museum in York, a post from which he is shortly to retire, Dr. W. E. Collinge has added much to the appearance and value of the exhibits there and to the scientific life of the city. The collections in the Museum are particularly rich in archaeological finds, and Dr. Collinge has lost no opportunity, by museum talks and tours and by newspaper articles, of making these and the other collections under his charge a fount of enlightenment to the citizens and to many visitors from beyond the walls. His scientific work has been largely economic. Almost alone in Britain he has persistently carried on a study of the food of birds, the first results of which were collected in a modest volume in 1913, and in 1924–1927 appeared in a revised and greatly enlarged edition which remains the standard work upon the food and economic standing of British wild birds. The two editions show an interesting trend in the method of food analysis, for while the first followed the good old British plan of recording the individual items of diet, the second reveals the influence of American workers in recording foods volumetrically and thus enabling the analyses to be summarized in spectacular diagrams. It is natural that Dr. Collinge's advice on matters of bird protection should have been much sought after, and for twenty years he has been a valuable member of the Scottish Wild Birds Advisory Committee appointed to advise the Scottish Home Department in connexion with the Wild Birds Protection Acts. As a member of many societies he has taken a prominent share in the promotion of natural science and archaeology in York.

Nicholas Aylmer Vigors, F.R.S., M.P. (1787–1840)

By the death on October 26, 1840, a century ago, of Nicholas Aylmer Vigors, M.P., the Zoological Society lost one of its most active members. Born at Old Leighlin, County Carlow, in 1787, Vigors was educated at Trinity College, Oxford, and then became an ensign in the Grenadier Guards. As such he served in the Peninsula War, was present at the battle of Barossa and was severely wounded. Returning to England he devoted himself to natural history, and especially to the study of birds and insects. As a member of the Linnaean Society he was one of the first members of the Zoological Club, from which in 1826 sprang the Zoological Society, of which he became the first secretary, and to the museum of which he presented a valuable collection of insects and birds. For several years he was the principal editor of the *Zoological Journal*. His best-known papers were those "On the Natural Affinities that

connect the Orders and Families of Birds" and "The Arrangement of the Genera of Birds". A land owner and a man of considerable wealth, he promoted the progress of science in various ways, while he also for several years sat in Parliament first for the city, and then for the county of Carlow. He was elected fellow of the Royal Society in 1826 and in 1832 was made a D.C.L. of Oxford.

Isolation of a Heavy Sulphur

At the hundredth meeting of the American Chemical Society, which opened at Detroit on September 9, Drs. David W. Stewart and Karl Cohen, of Columbia University, described the preparation of heavy sulphur. According to Science Service, of Washington, D.C., the researches were conducted under the direction of Prof. Harold C. Urey, head of the Department of Chemistry of the University, who received the Nobel prize for chemistry in 1934 for his work in the discovery of heavy hydrogen. Ordinary sulphur contains four isotopes; S^{32} (95 per cent); S^{34} (4 per cent), which is the isotope now isolated; S^{33} (1 per cent); and S^{36} (0·01 per cent). Separation of the isotope was achieved with Prof. Urey's counter-current scrubbing method, previously used to separate isotopes of carbon and of nitrogen. Sulphur dioxide was passed up through 150 ft. of sodium hydrogen sulphite flowing downwards. S^{34} is more soluble in the liquid than the other varieties; and, at the end of the process, the emergent liquid contained about a quarter of the heavy isotope. Researches are now being carried out by Dr. Vincent du Vigneaud, professor of biochemistry in the Cornell University School of Medicine, using heavy sulphur to determine the role of the element in the chemistry of the living organism.

Zoos in War-time

The North of England Zoological Society has maintained the collection at Chester during the first year of the War with little less than normal standards, despite a reduced staff and an increased stock due to evacuation from elsewhere. A noteworthy event has been the successful rearing of a young bird by the pair of griffon vultures; these birds have nested annually in recent years and previously hatched a chick, but they had not before succeeded in rearing it to maturity. The young bird is now fully fledged and the Society considers this a breeding record in British aviculture. The collection has received a pair of the wolves spared when the well-known pack of wolves at the Edinburgh Zoo was destroyed. The Chester Zoo is well stocked with lions and leopards, from which it is hoped to restock the depleted zoos of Europe when peace returns. The Society has just issued its monthly reports from June in a combined publication, and notes that it was the pioneer of the animal-adoption scheme later utilized with success by London, Edinburgh and Bristol: "We feel that it is in the country's interest that we should keep the Zoos alive to fulfil once again their functions when peace returns," states the Secretary.

Illuminating Engineering Society

The opening meeting for the session of the Illuminating Engineering Society was held in the Royal Institution on October 8. Prof. J. T. MacGregor-Morris, emeritus professor of electrical engineering in the University of London, the incoming president, delivered an address on "The Arc as a Standard of Light". In his opening remarks he recalled the classic experiments of Sir Humphry Davy on the electric arc, conducted at the Royal Institution shortly after 1800. It was not until 1881, however, that Captain Abney suggested that, in view of its constant temperature, the arc could be used as a standard of light. Between 1889 and 1894, Sylvanus Thomson, Mr. (now Sir James) Swinburne and M. Violle made further suggestions. To Mr. A. P. Trotter, however, and to M. A. Blondel the main credit should be given for a determined attack on this problem. In the course of this work an unexpected effect, the formation of a comma-shaped rotating spot of light at the positive crater, which Prof. MacGregor-Morris described as the "Trotter rotating comma", was encountered. This phenomenon was discussed in considerable detail. One interesting conclusion that emerges from recent researches is that, provided certain other quantities remain the same, the speed of rotation is remarkably constant. The direction of rotation can be controlled, but in general is a matter of chance. The disturbing influence of the Trotter rotating comma on the candle-power emitted by the crater was also discussed. In conclusion, Prof. MacGregor-Morris affirmed his conviction that a satisfactory high-temperature standard of light would result from the use of the three-electrode form of arc, which has recently been the subject of careful study. During the meeting, the Leon Gaster Memorial Premium was given to Mr. C. Dunbar for his paper entitled "Visual Efficiency in Coloured Light".

Science in the U.S.S.R.

An article by Prof. M. Ruhemann, "Science and the Soviet Citizen" (*Anglo-Soviet J.*, **1**, No. 3, July 1940), describes the way in which the gulf between the scientific worker and the general public is being bridged in the U.S.S.R. Professional science is organized as an integral part of the planned economy of the country, and the Academy of Sciences, which supervises the planning of scientific research, advises the State Planning Committee on the extent of the country's natural resources and on the possibilities of their scientific exploitation, while it plans scientific research in conformity with the needs of the community as ascertained by the State Planning Committee. The Academy possesses scientific research laboratories of its own, but most State organizations possess their own research laboratories.

While it is not so much the work of the individual scientific worker as the general direction of scientific research that is determined by the needs of the community, every man of science, however theoretical his work may be, is rightly convinced that its final object is to serve the community. Every scientific worker is also encouraged to look out for technical

possibilities arising from his work and not to rest content with publishing his results in a scientific journal. The method of recruiting men of science also encourages contact between scientific workers and the general public, while the whole educational system, as well as the use made of the Press and the influence of the trade unions, is directed to the development of a scientific attitude to life. A brief account of this aspect of education in the U.S.S.R. is contained in a further article "Preparing a Scientific Nation" by Beatrice King in the same number, while Dr. C. Norris, under the title "Experimental Medicine in the U.S.S.R.", describes some of the results achieved in medical research.

Telephone and Telegraph Statistics of the World

In *Electrical Communication* of July 1940, tables are given of the telephone and telegraph statistics of the world compiled by the American Telephone and Telegraph Company. The tables are compiled for the year ending January 1, 1939. The amount of telephone and telegraph wire in use in this period is also given. Except in the case of the United States and Canada, the telegraph service is operated by Governments. In the United States the number of miles of telephone line operated predominantly by private companies is nearly 93 million, and Canada comes next in the North American group with 5·4 million operated by private and Government concerns. In South America, the Argentine comes first with 1·58 million miles and Brazil second with 1·13 million miles, both privately worked. In Europe, Germany comes first with 18·0 million miles, and Great Britain and Northern Ireland jointly second with 15·2 million miles, both worked by Government. In Asia, Japan comes first with 4·8 million miles Government operated, and China is second with 0·8 million miles run by private companies and Government. In Africa, the Union of South Africa comes first with 0·83 million miles and Egypt is second with 0·47 million miles, and finally in Oceania Australia comes first with 2·83 million miles and New Zealand second with 0·11 million miles, all of which are operated by Government.

If we consider the percentage of telephone wire in operation possessed by the whole world, the United States possesses 53·2 per cent, Germany comes second with 10·3 per cent and Great Britain third with 8·7 per cent. Discussing the percentage of telephone line in the whole world possessed by a country per 100 of the population, it is stated that the United States comes an easy first with 71·5 per cent, Sweden is second with 49·2 and Canada third with 48·2. The total lengths of telegraph line possessed by each country run in the following order: United States 2·3 million miles, Russia 0·8 million miles and British India 0·37 million miles.

Oxford Electric Supply Undertaking

Mr. H. G. Fraser, the city electrical engineer of Oxford and manager of the electrical undertaking, can now claim for Oxford the second position among the records of the lists showing the number of units sold per head of the population relating to the authorized undertakings in Great Britain. According to the *Electrical Times* of October 3, the two main reasons why the revenue and units sold per head of the population exceeded all previous records of the undertaking were the connecting up of the heating installation of the New Bodleian Library during the early part of the summer, and the incidence of exceptionally severe weather conditions during the last quarter of the year. These two factors outweighed the general slump consequent upon the outbreak of war and the black-out. More than four million more units were sold for private lighting, heating and cooking, and this brought the total to 34 millions. This represents 563 units sold per head of the population. The surplus at £23,910 shows an improvement of £8,316.

Seismological Data from India

The *Seismological Bulletin* of the India and Ceylon seismological observatories for the period July–September 1939 has just been received. It has been published by the Government of India Meteorological Department under the direction of Dr. C. W. B. Normand. An average of eleven slight shocks and tremors daily was registered during July. It was estimated at the Colaba Observatory at Bombay that the earthquakes of July 12, 18, and 20 occurred near New Guinea, south of the Nicobar Islands and in the Pacific Ocean west of the Tonga Deep respectively. The latter probably had a depth of focus near 680 km. During August an average of ten earthquakes daily was recorded. The epicentre of the one on August 8 was in the ocean to the south-west of Ceylon, according to Colaba. It was felt over a large part of Ceylon.

The earthquake of August 25 was felt in New Guinea at Rabaul and Kokopo. During September an average of seventeen shocks was recorded, the one on September 8 being the greatest in the three months. It occurred in the Aleutian Islands though on the same day there was another shock to the south of Sumatra. According to Colaba, the shock of September 6 was in Afghanistan, and the ones of September 14, 19, 22, and 25, in the sea to the south-east of the Andaman Islands, to the south-east of Lake Aral, near Smyrna, and near the Nicobar Islands respectively. Macroseismic reports from voluntary observers mention eleven earthquakes and several tremors. The greatest of these, at Dhubri, had intensity 6 on the Rossi-Forel scale on August 21, other shocks being recorded from Drosh (3), Gauhati (2), Yatung, Tibet (2+ several tremors), Chaman and Dalhousie.

The Colombo Museum

Since Sir William Gregory in 1872 developed the idea of collecting exhibits illustrating the natural history, antiquities and industrial products of Ceylon, the Colombo Museum has preserved a high scientific standard while at the same time offering a centre of interest to the large number of people which visit its collections (334,528 in 1939). Although many influences have led to the preponderance of natural

history in the Museum, the report for 1939 shows that efforts are being successfully made to build up an adequate representation of the prehistory and ethnography of the island. Much of the progress of the Museum has been due to the enthusiasm and energy of two recent directors, Dr. J. Pearson, who retired in 1932, and his successor, A. H. Malpas, who retired in 1939 and to whose skill in increasing the popular attraction of the collection and encouragement of entomological, avifaunal and ethnographical surveys the report pays a warm tribute. P. E. P. Deraniyagala has been appointed acting director and is responsible for the administration report. Its brief account of the activities of the museum staff and its considerable list of donations and other acquisitions to the various groups of collections indicate that the institution continues to strengthen its position as the conservator of Ceylon interests and a centre of scientific study.

Shrinkage of Australian Timbers

Pamphlet No. 97, 1940, of the Australian Council for Scientific and Industrial Research, written by W. L. Greenhill, is devoted to the above subject. Owing to the needs for war-time economy, photolithography instead of printing has been used in its production. The aim of the pamphlet is to give shrinkage values for the more important Australian timbers (170 kinds are dealt with). The data are presented in such a manner that they can be readily applied in industry. Sufficient information is given so that a full picture of the behaviour of the various timbers can be obtained from the point of view of shrinkage or swelling with changes of the moisture content. The correlation between shrinkage and density among different timbers is shown to be very small and is not always significant even within a single species. Data of the kind assembled in this pamphlet are an essential aid to the utilization of the timbers concerned and to their effective competition with substitutes. The testing procedure followed in determining the shrinkage values recorded in this pamphlet is essentially the same as that adopted by the American Society for Testing Materials in 1927. The specifications provide for measuring the volumetric, tangential and radial shrinkages.

Proceedings of the Royal Society of Edinburgh

Owing to the national necessity for exercising the strictest economy in paper, and in order to reduce the expense of printing and publication, the Royal Society of Edinburgh has decided that, as from vol. 61, 1940–41, the *Proceedings* shall be published in two sections, namely, "A" (Mathematical and Physical—including Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology, and Physics) and "B" (Biological—including Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, and Zoology). Fellows of the Society, and institutions with which the Society exchanges publications, will benefit under this arrangement by having, in smaller compass, papers dealing with the subjects in which they specialize. No change is proposed in the present form or in the arrangement for the distribution of the Society's *Transactions*. The obituary notices of fellows, proceedings of meetings, list of fellows, prizes, etc., formerly published as appendixes at the end of each session's volume of *Proceedings* will, under the new scheme, be published separately, and will be sent normally to all fellows and to those exchanges specially desiring to receive them.

The Night Sky in November

The moon is full on November 15 at 2·4h. U.T. and new on November 29 at 8·7h. On November 11 at 23h. Mercury is in inferior conjunction, and a transit across the sun's disk occurs. The transit is visible generally in North and South America, the Pacific Ocean and Australasia. Lunar conjunctions with the planets occur as follows: November 13d. 23h. with Jupiter; November 14d. 2h. with Saturn; November 26d. 22h. with Venus; November 27d. 3h. with Mars and November 27d. 22h. with Mercury. Three planets are in opposition during this month; on November 3, Jupiter and Saturn, their respective distances from the earth being 370 and 763 million miles. On November 16, Uranus is in opposition, its distance from the earth then being 1,725 million miles. On November 11, this distant planet will make a close approach to the 8th magnitude star B.D. $+18°494$. Venus is still the bright morning star rising at about 3h. at the beginning of the month and at 4h. at the end. The configurations of Jupiter's inner satellites are given in the *Nautical Almanac*, p. 628–629 and in *Whitaker's Almanack*, p. 176. Mars is now a morning star, and will pass 3° north of Spica on November 8.

Announcements

The Lord President of the Council has appointed Prof. A. V. Hill, O.B.E., Sec.R.S., M.P., Foulerton research professor of the Royal Society, Sir Felix Pole, chairman of Associated Electrical Industries, Ltd., and Sir Robert Robinson, F.R.S., Waynflete professor of chemistry in the University of Oxford, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. W. H. Mills, Prof. A. Robertson, Sir Albert Seward, and Sir Harry Shackleton have retired from the Council on completion of their terms of office.

The Crompton Medal, given for the best paper read before the senior centres of the Institution of Automobile Engineers during the session, has been awarded to Dr. J. S. Clarke, of Birmingham Corporation Gas Department, for his paper "The Use of Gas as a Fuel for Motor-Vehicles".

In 1939 there were 61,184 deaths from tuberculosis in the United States as compared with 63,677 in 1938. The death-rate dropped from 48·9 per 100,000 of population in 1938 to 46·6 in 1939. Except for Delaware, the death-rate in all States declined or remained within a decimal point higher than the 1938 figure.

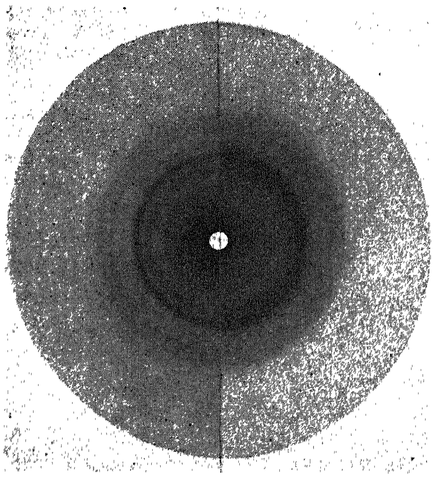
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

X-Ray Comparison of Natural and Synthetic Starch

IT has recently been described[1] how starch is synthesized *in vitro* from glucose-1-phosphate by the action of an enzyme, phosphorylase, which is present in many plants. In the light of this reaction, and of



other recent enzymic and chemical data, we have undertaken a re-examination of the starch problem by X-rays. As a first step we have examined the synthetic polysaccharide formed by the action of phosphorylase from potatoes.

Natural starch gives surprisingly good X-ray powder photographs, indicating crystallites built from molecules that are probably all alike, or very nearly alike. Four principal types of photograph are known, the so-called *A*-, *B*-, *C*- and *V*-photographs, characteristic of the plant source or mode of preparation of the starch[2]. *A* is typified by wheat starch, *B* by potato starch, *C* is almost certainly a mixture of *A* and *B*, while *V* is found after precipitation by alcohol. The accompanying reproduction provides a comparison of (left) purified potato starch in the form of grains and (right) the polysaccharide synthesized by the action of potato phosphorylase on glucose-1-phosphate. The latter consisted exclusively of small grains, in which form the bulk of the synthetic product is deposited during the course of the enzymic synthesis. It will be seen that the two preparations give essentially the same pattern (*B*-pattern), even though that of the synthetic starch is not quite so sharp.

In certain of its properties synthetic starch shows a closer resemblance to the amylo-amylose fraction of natural starch than to normal whole starch[1]. A specimen of amylo-amylose (precipitated by alcohol after electrophoretic separation) was found to give a *V*-photograph, whereas a sample of the synthetic starch after precipitation by alcohol gave the *B*-photograph. Further investigation of the conditions governing the appearance of one or other pattern will clearly be necessary before we can hope to correlate the differences between types and fractions of starch with their X-ray patterns.

An important point for the elucidation of the starch problem by X-rays is the significance of the *A*-, *B*- and *C*-photographs. Are these to be traced to the existence of slightly different phosphorylases, or are they rather a function of the conditions of crystallization? There is evidence that the latter explanation is the more likely, since it is reported that the same starch may give either an *A*-, a *B*- or a *C*-photograph according to the temperature of deposition[3]; but the question obviously invites a study of phosphorylases prepared from a variety of plant sources.

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FLORENCE O. BELL.
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University of Leeds.

CHARLES S. HANES.
Low Temperature Research Station,
Cambridge.
Sept. 18.

[1] Hanes, C. S., NATURE, **145**, 348 (1940); *Proc. Roy. Soc.*, B, **129**, 174 (1940).
[2] See Katz, J. R., "Die Röntgenspektrographie als Untersuchungsmethode bei hochmolekularen Substanzen usw.". (Berlin and Wien, 1934).
[3] Katz, J. R., and Derksen, J. C., *Z. phys. Chem.*, A, **165**, 228 (1933).

Anatomical Basis of Colour Vision

ONE of the criticisms commonly made in respect of the Young-Helmholtz trichromatic theory of colour vision is the lack of any anatomical evidence for the three sets of sensory receptors in the mammalian retina which are postulated by the theory, or for the three sets of optic nerve fibres which presumably connect them with the brain. It is worth while, therefore, to direct attention to the fact that there is a possible anatomical basis for the three sets of fibres.

The lateral geniculate body (that is, the centre through which the retinal impulses are projected on to the cerebral cortex) is composed of six well-defined

layers of cells in man and the higher primates. Many years ago it was shown by Minkowski (on the basis of transneuronal degeneration following section of the optic nerve) that crossed retinal fibres end in layers 1, 4, and 6, and uncrossed fibres in layers 2, 3, and 5. More recently[1], these observations were confirmed and amplified by the study of the effects of small intra-ocular lesions of the retina in the monkey; in the course of this work it became apparent that the smallest retinal lesion which leads to a detectable change in the lateral geniculate body always involves a group of cells (of approximately equivalent size) in *all* the corresponding three layers, these cells being disposed as a straight band radiating from the hilum of the geniculate body to its convex surface. In other words, it appears that the *receptive unit* of the lateral geniculate body with respect to each retina is a narrow band of cells radiating from the hilum and involving either the cell-laminæ 1, 4, and 6 (heterolateral fibres) or 2, 3, and 5 (homolateral fibres).

From this observation it may be inferred *either*: (1) that each single retinal fibre on arrival at the lateral geniculate body divides into three terminals, each passing to one of the three corresponding cell-laminæ, *or* (2) that the conducting unit in each optic nerve in relation to the lateral geniculate body consists of three fibres arising from adjacent ganglion cells of the retina, and that of these three fibres (in the case, for example, of crossed fibres), one terminates in cell-lamina 1, a second in lamina 4, and a third in lamina 6. It may be said at once that there is no neurohistological evidence for the first alternative, and that the second, therefore, is more probably correct.

But the Young-Helmholtz theory also postulates that the conducting unit of the optic nerve (so far as colour vision is concerned) should consist of three fibres, related respectively to the sensations of red, green and violet. Hence it may be said that our experimental studies of the lateral geniculate body provide quite definite anatomical support for the theory.

Until further direct evidence is available, of course, the implication that each set of three cell-layers in the lateral geniculate body is related to the fact that normal colour vision is trichromatic can only be regarded as an interesting speculation. It is not impossible that the histological study of the lateral geniculate body of colour-blind individuals might lead to definite results, but such specimens are naturally hard to come by. There are, however, two other points regarding the normal geniculate body which are apposite to the problem. One of these is that the fully developed six-layer formation is only found in the primates, and the primates are the only mammals so far known by properly controlled testing to have full colour vision. The other point is that, in the monkey (and also in man), the full development of the six layers is only found in that part of the nucleus concerned with central vision. In the rostral portion and the lateral and medial borders of the caudal two thirds, the six laminæ merge with each other to a considerable extent, and these regions are concerned with extreme peripheral vision where the recognition of colour distinction, of course, is not possible.

W. E. Le Gros Clark.

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Oct. 4.

[1] Le Gros Clark, W. E., and Penman, G. G., *Proc. Roy. Soc.*, B, **114**, 129 (1934).

l-Galactose as a Component of a Polysaccharide of Animal Origin

In the course of a study of the products obtained by the methanolysis of methylated galactogen, the parent polysaccharide having been prepared from the albumin glands of *Helix pomatia*, we obtained by distillation in a high vacuum certain fractions the properties of which indicated that they consisted wholly of pentamethyl hexose, apparently 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactoside. One of us[1] has recently investigated the $n_D^{16°}/[\alpha]_D$ (in water) relationship of mixtures of the α- and β-forms of this galactoside; on making use of these observations, it was found that the $[\alpha]_D$ values of our fractions were much smaller than was to be expected from the observed $n_D^{16°}$ values. Thus in one fraction showing $n_D^{16°}$ 1·4494, the $[\alpha]_D$ was found to be $+55·6°$ as against the expected value of $+118°$. This suggested that the fraction in question must have contained only about 75 per cent of 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactosides, together with 25 per cent of the corresponding derivatives of *l*-galactose: no sugars other than *d*- and *l*-galactoses appeared to be present from consideration of the yields of mucic acid produced on oxidation of the galactogen by nitric acid.

Careful fractionation of the products obtained by splitting methylated galactogen with methyl-alcoholic hydrogen chloride indicated that the original polysaccharide contained a total number of galactose units equal to seven, or a multiple of seven, and that of these one in every seven arises from *l*-galactose, the others being derived from the *d*-isomer. The same conclusion was reached from considerations of the final $[\alpha]_D$ observed in acid hydrolysates of galactogen itself. If the latter consisted wholly of condensed residues of *d*-galactose, a final $[\alpha]_D$ value of $+80·5°$ (calc. on sugar present) would be anticipated, but May[2] had already reported that a value of only $+53·6°$ is attained. He explained the discrepancy by supposing that he had to deal with "β-*d*-galactose" ($[\alpha]_D = +53°$), stabilized in some manner hitherto unknown. Some time ago[3], we carefully repeated May's experiment and found a final value of $+56·5°$, which agrees closely with that of $+57·5°$ which can be calculated for an equilibrated mixture of six parts of *d*-galactose with one of the *l*-isomer.

l-Galactose, usually accompanied by the *d*-isomer, has been detected in a few biological materials of plant origin. Thus it has been obtained from Chagual gum[4], from the Japanese drug Nori[5], from quince gum[6], from flax-seed mucilage[7] and from agar[8]. So far as we are aware, however, this is the first instance in which the presence of *l*-galactose has been suspected in a material of animal origin. We therefore took steps to isolate from acid hydrolysates of galactogen a characteristic derivative of this uncommon sugar.

After neutralizing the acid and isolating the combined sugars, a quantity of crystalline *d*-galactose was isolated by fractional crystallization from 90 per cent alcohol. The residual solution was then decolourized with charcoal and evaporated to dryness, the residue being dissolved in boiling 97 per cent alcohol, from which a syrup separated on cooling. This was rejected and the material remaining in the mother liquors was recovered by evaporating the solvent. From this residue, and from *dl*-galactose, we prepared crystalline benzimidazole derivatives by the method of Moore and Link[9]. The two products

had the same characteristic crystalline form and melting point (233°, separately or mixed) and both were optically inactive. Analysis of the specimens of *dl*-galacto-2-benzimidazole provided confirmation of their identity :

	% C	% H	% N
Product from galactogen ..	53·3	6·4	10·0
Product from *dl*-galactose ..	53·5	6·3	10·4
Calculated for $C_{12}H_{16}O_5N_2$ ..	53·7	5·97	10·4

This work will be described in more detail in a forthcoming paper.

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DAVID JAMES BELL.
ERNEST BALDWIN.

[1] Bell, *J. Chem. Soc.*, in the Press (1940).
[2] May, *Z. Biol.*, **95**, 277 (1934).
[3] Baldwin and Bell, *J. Chem. Soc.*, 1461 (1938).
[4] Winterstein, *Ber.*, **31**, 1571 (1898).
[5] Oshima and Tollens, *Ber.*, **34**, 1422 (1901).
[6] v. Lippmann, *Ber.*, **55**, 3038 (1922).
[7] Anderson, *J. Biol. Chem.*, **100**, 249 (1933).
[8] Pirie, *Biochem. J.*, **30**, 369 (1936).
[9] Moore and Link, *J. Biol. Chem.*, **133**, 293 (1940).

Hydration of Substituted Amides of Stearic Acid

PREVIOUS work[1,2] has indicated that in hydrated stearanilide the bound water is held by a micellar structure. It has also been shown[1] that a chain containing at least sixteen carbon atoms is necessary for water-binding by anilides of normal fatty acids. Further investigation of factors influencing hydration has now been made.

5-gm. samples of derivatives of stearanilide were hydrated and examined in the manner already described[1]. In the accompanying table are recorded the percentages of bound water in a selection of hydrated compounds.

Hydrated compound	Percentage water	Hydrated compound	Percentage water
Stearanilide	88·5	*o*-Carboxy-stearanilide	21·6
Stear-*o*-toluidide	86·3	*m*-Carboxy-stearanilide	70·8
Stear-*m*-toluidide	71·8	*p*-Carboxy-stearanilide	53·4
Stear-*p*-toluidide	85·3	Stear-diphenylamide	0·7
Stear-methylanilide	0·3	Stear-α-naphthylamide	77·4
Stear-*o*-nitranilide	80·0	Stear-β-naphthylamide	84·9
Stear-*m*-nitranilide	80·8	Stear-phenylhydrazide	71·7
Stear-*p*-nitranilide	87·5	Stearamide	85·5
p-Bromo-stearanilide	81·4	Stearic acid	72·5

A study of these results shows that with certain notable exceptions all the compounds examined are capable of binding large quantities of water. Evidently the introduction of substituents into the nucleus of stearanilide has little effect on water-binding capacity, though a carboxyl group in the *o*- or *p*-position reduces the amount of water bound. Replacement of the remaining hydrogen atom of the amino group, however, effectively prevents hydration, as is shown by the fact that both stear-methylanilide and stear-diphenylamide are incapable of taking up water.

An explanation of this may be based on the assumption that the formation of a micellar structure and the binding of water by it are consequences of enolization resulting in the transformation of the -CO-NH- grouping to -C(OH)-N-. The fundamental importance of enolization is deduced from the fact that both stearamide and stearic acid become heavily hydrated and hence neither the benzene nucleus nor the nitrogen atom can be primarily responsible for the binding of water. It seems not unreasonable to suppose that the micellar structure formed has the character of a fibrillar meshwork, or felt, in the interstices of which water becomes entrapped. The bulk of the water is probably located around the -C(OH)- groups, and its presence, coupled with attractive forces between these groups in neighbouring molecules, may be largely responsible for the construction and stability of the felt. The influence of the solvent (alcohol) cannot, however, be ignored and this aspect of the problem is now being studied.

B. A. TOMS.
Department of Chemistry, The Queen's University, Belfast. Sept. 12.

[1] NATURE, **145**, 1019 (1940).
[2] NATURE, **146**, 266 (1940).

A Cambridge Pleistocene Climate

MR. T. T. PATERSON's demonstration of the 'frost cracks' in the Travellers' Rest pit at Cambridge[1] affords a valuable clue to a Pleistocene climate of that region. The presence of permanently frozen ground in England within Pleistocene times has been suspected, but proof has been wanting. 'Frost cracks' in active formation are occupied by wedges of ice and they can only attain a considerable width in ground which remains frozen for many years. E. de K. Leffingwell considered the ice wedges in cracks in northern Alaska to have grown by successive annual increments of a few millimetres and he estimated that the wedges, which are up to three metres across, had taken 500–1,000 years to form[2]. Some of the Travellers' Rest fissures are nearly two metres across and they indicate a prolonged period of low temperatures.

G. Holmsen's finding that ground ice may occur where the mean annual temperature is 25° F. or lower is generally accepted[3], and from an examination of the distribution of the permanently frozen ground in Northern Canada, W. A. Johnston concludes that it is likely to occur where the mean annual temperature is "say 26° F. or lower"[4]. The present (1906–35) mean temperature of Cambridge is 49·3° F. 'Frost cracking' cannot take place beneath any considerable snow cover and the precipitation must have been low. At present (1885–1915) the annual precipitation is 21·82 inches, ground frosts occur on 112 days, and snow lies in the morning on only 12 days in the year[5].

Mr. Paterson's evidence proves the soundness of the conclusions reached by C. Reid more than fifty years ago from a study of the character of the cold fauna and flora of the Pleistocene period, that the mean temperature in the south of England was considerably below the freezing point ("probably about 30° lower than now") and "consequently all rocks not protected by snow would be permanently frozen"[6].

L. HAWKES.
Bedford College for Women at "Springfield", Sidgwick Avenue, Cambridge.
Oct. 4.

[1] *Quart. J. Geol. Soc.*, **96**, 99 (1940).
[2] U.S. Geol. Surv. Prof. Paper, **109**, 211 (1919).
[3] *Norsk. Geog. Selsk. Aarbok*, **24**, 131 (1912–13).
[4] *Trans. Roy. Soc. Canada*, Sec. 4, **24**, 39 (1930).
[5] "The Cambridge Region", Camb. Univ. Press (1938).
[6] *Quart. J. Geol. Soc.*, **43**, 369 (1887).

RESEARCH ITEMS

Storage of Chemical Activator by Body Lipoids

A PAPER on "Fats and Oils as Protective Repositories of Neurohumors and other Chemical Activators" was read by G. H. Parker, of Harvard University, at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The colour changes in catfish are controlled by three chief neurohumours, intermedin from the pituitary gland, acetylcholine and a concentrating neurohumour (probably adrenaline) from the dispersing and the concentrating nerve-fibres respectively. Of these three, the two from the nerves, acetylcholine and adrenaline, are soluble in fats and oils. Acetylcholine induces a dispersion of melanophore pigment and consequently a darkening of the fish. Adrenaline, on the other hand, concentrates this pigment and blanches the fish. When acetylcholine has been discharged for some time from the dispersing nerves, it accumulates in the fatty or lipoid constituents of the tissues about the melanophores, and in consequence continues the dispersion of pigment for some time after the dispersing nerves have ceased to act. It can be extracted in measurable amounts from dark fish skins. It escapes destruction by choline esterase by its retreat into fatty materials, where it is temporarily stored. The same appears to be true of adrenaline, another important general nerve activator. Thus the fatty or lipoid substances in the animal body may serve as storage reservoirs for agents that may be of first consequence in the animal economy. This storage activity of lipoids for important activating agents has not received the attention of biologists that it probably deserves.

Fossil Birds of North America

IN 1931 the American Ornithologists' Union included a list of fossil forms in its Check-list of North American Birds. The past nine years, however, had made many additions and some changes, and in order that these, recorded in many scattered papers, should be brought together, Alexander Wetmore has compiled a new "Check-list of the Fossil Birds of North America" (*Smithsonian Misc. Coll.*, **99**, No. 4; June 1940). The list runs to 81 pages, and includes 184 species of birds now extinct, including the New World toothed birds (Odontognathæ) made famous by the researches of Marsh. In addition, there are included 165 species of birds which are still living, but the remains of which have been found in Pleistocene deposits, generally in caves and in the rich fossiliferous beds of the asphalt lake of Rancho La Brea.

Barnacles attached to Birds

A NOTE by Granville Ashcraft records the curious occurrence of barnacles growing upon the breast feathers of living birds (*Condor*, **42**, 218; 1940). Two Pacific fulmars, *Fulmarus glacialis rodgersii*, were shot on the wing while they circled the Allan Hancock Foundation cruiser dredging for marine life off San Francisco Bay, California. Several dozen clusters, each containing three or four individuals of young stalked barnacles, *Lepas hillii*, were found to be attached to the barbs of the belly feathers. The occurrence illustrates the mass settling of barnacle larvæ, which must have taken place when the fulmars were persistently roosting upon the water, and since this species of barnacle is not tolerant of conditions of drought, it indicates that during the period when the barnacles were growing the birds must have been on the ocean most of the time. The largest had a capitulum 3·0 mm. long and a stalk of 1·1 mm. So long ago as 1874 Targioni-Tozzetti proposed a new generic name (Ornitholepas) for barnacles growing upon the tail feathers of *Priofinus cinereus*, but later workers regarded the specimens as only a larval cirripede in its cypris stage.

Graptolites of Australia

AUSTRALIA has taken a considerable share in developing the knowledge of graptolites and their value as indicators in the interpretation of stratigraphical zones, since Frederick McCoy was appointed palæontologist to the Geological Survey in 1856. But much of the early work has been overlooked, and R. A. Keble and Prof. W. N. Benson have done good service in recording the full bibliography and the history of research on Australian graptolites (*Mem. Nat. Mus. Melbourne*, No. 11, 11–99; 1939). Titles of 159 papers bearing on Australian forms are listed, and the progress of research is discussed in three periods: the first period, 1856–1892, was a preliminary period of recording and correlation with the European and American faunas; the second, 1892–1932, introduced more detailed zoning and the recognition of an Australian stratigraphical sequence; the third, 1932 to the present, is the period of revision and systematization. The fauna, the history of the discovery of which is summarized by the authors, is probably the most complete graptolite fauna in the world, certainly in regard to its Ordovician components, and it is remarkable that so great a similarity exists in the Upper Ordovician of Australia and of Great Britain that "with further work it may even be possible to adopt the English classification".

Hereditary Nose-Bleeding

RECURRENT nose-bleeding is inherited as a Mendelian dominant in a family of the United States. H. K. Fink (*J. Hered.*, **31**, 319–322; 1940) gives a pedigree involving six generations in which the affected individuals developed heavy nose-bleeding from about the time of puberty. It has been found that diet involving calcium lactate considerably alleviates the amount and frequency of bleeding.

Linkage in the Human Sex Chromosome

T. WHITE (*J. Genetics*, **40**, 403–437; 1940) reports a pedigree involving seven generations which exhibits congenital stationary night-blindness, myopia and deuteronopia. The pedigree indicates that these defects were all on one X-chromosome, but have on several occasions crossed over in a female. In an appendix, J. B. S. Haldane discusses the calculation of the cross-over percentage between the genes involved.

Sodium Polyiodides

As is well known, iodine is much more soluble in solutions of alkali iodides than in pure water, and this is the result of the formation of polyiodides, for example, KI_3, in solution. Many of these polyiodides have been isolated in the solid form, many being anhydrous, but the potassium compounds are known only as hydrates, KI_3, H_2O and KI_7, H_2O. G. H. Cheesman, D. R. Duncan and I. W. H. Harris (*J. Chem. Soc.*, 837; 1940) in a phase-rule study of the system $NaI-I_2-H_2O$ at 0° conclude that the compounds NaI_4, $2H_2O$ and (possibly) NaI_2, $3H_2O$ are stable at that temperature. The di-iodide (which may be NaI, NaI_3, $6H_2O$) is the first example described of a polyiodide of this type. The numbers of iodine atoms combined with one atom of sodium are both even, whereas in the potassium system the numbers are odd. Even polyiodides (for example, CsI_4, $2KBr_6$, $3H_2O$ and possibly $CsBr_4$), however, have been previously reported. The alternative formulation NaI, NaI_3, $6H_2O$, it is pointed out, would agree better with the physico-chemical evidence for a dissociated tri-iodide ion in solutions: $I'_3 \rightleftharpoons I_2 + I'$, higher polyiodide ions being formed when the proportion of iodine is high.

Synthesis of Radioactive Lactic Acid

G. B. Kistiakowsky and Richard Cramer, of Harvard University, described this work at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. Lactic acid containing the C^{11} isotope in the carboxylic position was synthesized from carbon oxides produced by the bombardment of boron oxide by deuterons in the Harvard cyclotron. The oxides were converted to carbon dioxide and thence to potassium cyanide; this combined with acetaldehyde in alkaline solution to give a α-hydroxy-propionitrile which was hydrolysed by hydrochloric acid to lactic acid. The mixture was made alkaline again, evaporated to dryness and extracted with acidic dry ether to eliminate inorganic materials. The ether phase was then extracted with water to separate lactic acid from polymerized acetaldehyde and concentrated to about 2 c.c. volume containing some 50 mgm. of lactic acid, to which 100 mgm. of ordinary *d-l* lactic acid were added when needed. The entire synthesis took approximately 1½ hr., the yield of C^{11}, allowing for radioactive decay, being about 30 per cent. The residual radioactivity was sufficiently strong to follow it for approximately five hours, and thus the acid could be used in biological experiments.

Crystallization Curves of Solid Solutions

N. L. BOWEN, of the University of Chicago, presented a paper on "Nodal Points on Crystallization Curves of Solid Solutions" at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The crystallization curves in solid solution systems characterized by a valley curve (Tallinie) on the fusion surface have been treated by Schreinemakers for the case of crystallization with perfect fractionation. He did not examine the case of crystallization curves with perfect equilibrium; but other investigators have done so, and they agree that the curves of perfect equilibrium crystallization have points of inflexion where they intersect the valley curve. On the other hand, there is no agreement among them as to the manner of location of the point of intersection with the valley curve. This confused condition suggested a new analysis of the problem, which shows that the point of intersection of valley curve and crystallization curve is determined by a simple construction, that a crystallization curve has no unique properties at this point, that some crystallization curves have nodal points but the locus of nodes is a curve which is independent of the valley curve.

A New Conduction of Heat Phenomenon

G. W. STEWART, of the State University of Iowa, presented a paper under this title at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. It is currently accepted that the transfer of energy in the conduction of heat in solids and liquids occurs by means of acoustic waves. In solids these consist of longitudinal elastic waves. In liquids it has recently been argued by Lucas that the more important carriers are transverse waves of viscosity and inertia. A new phenomenon in heat conduction has been found which is most easily interpreted by the presence of these transverse waves of viscosity and inertia. If the molecular swarms in liquid crystalline *para*-azoxyanisol are studied by means of X-ray diffraction, facts may be obtained concerning the orientation of these elongated swarms under the application of either the magnetic field or heat conduction. It is demonstrated that the swarms are oriented by the conduction of heat, their long axes perpendicular to the direction of the conduction. This phenomenon has been established by two experimenters, Holland and Reynolds, with different apparatus and methods. The orientation of the swarms corresponds to the effect of a cross-convection current. The transverse waves of Lucas may produce this result. These experiments demonstrate a new phenomenon and also add credence to the importance of the transverse waves of viscosity and inertia.

Corrosion Resistant Alloys

H. H. Uhlig and John Wulff, of the Massachusetts Institute of Technology, discussed this subject in a paper before the annual meeting during April 22–23 of the U.S. National Academy of Sciences. Various solid solution alloys of the transition and pre-transition group elements have wide application due to their corrosion resistance. This is attributed to their passivity, which is usually explained on the basis of an impervious oxide film. Electrochemical, threshold potential and corrosion data are not explained in simple terms on this point of view. A consideration of such data for iron-chromium, iron-nickel and copper-nickel alloys shows that corrosion resistance begins at critical alloy compositions; thus, atomic ratios of five Fe atoms to one Cr, or two Fe to one Ni are sufficient to induce passivity. This may be attributed to the ability of Cr in the Fe-Cr system to provide sharing possibilities for five electrons of the five nearest Fe neighbours, based on the assumption that Fe with one shared electron is passive. The solution of hydrogen in the surface lattice destroys passivity, the hydrogen electrons displacing Fe-Cr bonds. Chemo-sorption of oxygen may enhance the passive nature of boundary alloy compositions as well as pure metals by electron sharing similar to Cr. The present electron sharing point of view harmonizes many of the divergent theories concerning the passivity of pure metals and provides plausible explanation for the corrosion resistant alloys of the transition elements.

DIRECTIONAL STABILITY OF SHIPS

THE two qualities which jointly may be said to constitute the steering performance of a ship are its manœuvrability and its course-keeping ability. In experimental work and full-scale trials, attention has usually been directed to the first of these.

It is recognized that the two are to some extent opposed. A vessel which answers the helm readily is likely to show a greater tendency to yaw from a straight course, even when no rudder is applied, than one which is less easily manœuvred. The relative importance of the two qualities depends on the service for which the ship is designed. Coasters and cross-channel boats require greater facility in handling than ocean-going ships which spend most of their time at sea and do not have to enter small harbours without the assistance of tugs. The lack of directional stability tends to increase the extent to which the rudder must be used to maintain a steady course, and this is known to influence the horse-power required and hence the fuel consumption for a given average speed. When automatic steering is employed, the stabilizing effect of the gyro-pilot must be sufficient to overcome any inherent lack of directional stability in the ship itself. Quantitative prediction of the vessel's properties in this respect requires experimental work on the course-keeping of the model hull.

In *Engineering* of October 4, Dr. Lockwood Taylor discusses the methods by which such tests can be carried out in practice. It is not usually feasible to give positive directional stability to any ordinary ship of normal form, in the sense that an aircraft having sufficient rear-fin area has it. In the case of a ship, the form-factors involved are principally the profile of the forefoot and the extent of the after deadwood. But as the amount of latitude in fixing these is restricted by resistance, docking and structural considerations, any slight accidental yaw that the ship may acquire tends to accentuate itself. It is difficult to make any direct measure of this with accuracy. Resort is therefore had to an indirect method involving a special technique.

The direct method is to tow the model in the ordinary way and, when a steady speed has been reached, to release it from the guides which normally prevent yawing and to record the free motion which results. An indirect measure of what the author terms the static directional stability can be got by a method suggested by aeronautical practice in wind-tunnel tests on the longitudinal stabilities of aeroplanes. The model is towed at a small fixed angle of yaw, and the corresponding ship-turning moment about amidships is measured. The greater the unstable yawing moment at a given angle, the more rapid the rate of development of a swing under free conditions.

To obtain information about the dynamic or damping moment, it is necessary to use a method in which actual swinging of the model occurs. To control the motion and render it stable and oscillatory, a torsion spring of sufficient stiffness more than to balance the unstable hydrodynamic moment is fitted at the pivoting point. The constrained model has then a definite yawing period, from which, in conjunction with the known strength of the spring, the desired information as to the variation of yawing moment with angular position can be deduced. The records obtained from the oscillation of the spring-controlled model give after analysis the hydrodynamic damping.

PHYSICAL CONTROLS IN ADJUSTMENTS OF THE EARTH'S CRUST

DR. NORMAN L. BOWEN, professor of petrology at the University of Chicago, speaking on internal movements in the earth at the Bicentennial Conference of the University of Pennsylvania on September 19, pointed out that because man's activities are limited to the surface of the earth and to a short distance above and below the surface, his knowledge of the structure of the great interior bulk of the planet has necessarily been derived from such indirect evidence as the behaviour of earthquake waves passing through it. It is not surprising, therefore, that differences of opinion exist among geologists as to how the continents, oceans and mountains were formed. But upon one thing all are agreed. The earth is not and probably never has been a solid, unyielding block of material. Beneath the crust there is considerable mobility, usually slow and ponderous, to be sure, but movement nevertheless; and the mobility, all geologists are agreed, is dependent upon a gradient of temperature.

Major deformation of the earth's crust has been referred to four different types of action: (*a*) contraction of the earth as a result of cooling; (*b*) invasion of liquid magma; (*c*) interior convection currents and (*d*) migration of continents. There is the greatest diversity of opinion as to which of these actions accounts most satisfactorily for the major surface features of the earth, but whatever may be the truth, it is certain that each of them is either caused or controlled by the earth's temperature gradient.

Dr. Bowen pointed out that thermal shrinking of the earth could occur only if the earth was losing heat. Upward invasion by magma (molten rock) can only occur if there is, below the cold exterior, material at sufficiently high temperature to permit flow toward the surface and extrusion upon the surface. Convection currents can occur only if there is a temperature gradient, with hot mobile material lying below colder material. Migration of continents can only take place if there are, beneath the rigid continental masses, materials of sufficient mobility to permit sliding.

The earth's internal temperature is suggested by

the high heat (1,150°) of basaltic lavas thrown out by volcanoes, and also by measurements in bore holes. But the deepest holes have penetrated considerably less than two miles of the earth's crust, and this is such an insignificant proportion of the radius of the earth (which is 4,000 miles) that it gives only a very insecure basis for the estimation of deep temperatures.

Conflicting with the theory that the sub-crustal material is fluid (which seems necessary to account for the mobility) is the fact that it behaves towards tidal forces as would a highly rigid body. Its free transmission of earthquake waves also suggests a solid earth.

Dr. Bowen outlined efforts which have been made to reconcile these conditions. One suggestion is that the interior liquid is subject to such high pressure that it exhibits characteristics of rigidity toward forces of short duration, but 'gives' as a thick fluid under the stress of long-continued forces. Another view is that the earth is entirely crystalline, but shows mobility by granular readjustment, accomplished partly by elastic effects and partly by re-crystallization.

Dr. R. A. Daly, of Harvard, has proposed the theory that beneath the crust there is a shell of glassy basalt, above its melting temperature but held in an almost solid state by this intense pressure. When the pressure is released at any point the basalt becomes a thin fluid and erupts.

Dr. Bowen's own theory involves what is termed 'selective fusion'. He believes that the basalt is a crystalline layer held under pressure near but above its crystallization temperature. As the pressure is relieved those ingredients of the rock layer which have the lowest melting point become fluid, carrying in suspension those ingredients whch have a higher melting point and which are, therefore, still in crystalline form.

PERIODICITIES IN SOLAR VARIATION REFLECTED IN WEATHER

DR. CHARLES GREELEY ABBOT, secretary of the Smithsonian Institution, in a paper at the Bicentennial Conference of the University of Pennsylvania on September 17, stated that he has found periodicities in solar variations, which range in length from 8 months to 273 months, that have continued without change of phase for at least a century. The variations under discussion do not include those short-interval sequences of rise and fall in solar variation which cover but a few days each and which govern weather changes for the subsequent two or three weeks. While these are important, he dealt with the longer cycles which have more pronounced effects on temperature and rainfall and which "through these agencies influence production, prices, and social concerns of major interest".

Observations have been made by Dr. Abbot and collaborators at stations on mountains in desert regions all over the world, where the strength of the sun's radiation can be measured with the least possible interference from local atmospheric conditions. He now has a series of measurements covering most of the days of each year since 1920, and the study of these indicates that the sun's radiation changes within the range of 0·5–1 per cent in cycles of the following lengths:

8	months	39½	months
9¾	,,	45¼	,,
11¼	,,	68	,,
21	,,	91	,,
24·9	,,	137	,,

273 months

The least common multiple of these periods is 273 months, which is approximately twice the length of the sunspot period of 11⅜ years; it may be noted that the late Prof. G. E. Hale showed that magnetism in the sunspots has a period of two sunspot cycles.

Dr. Abbot, although his daily solar observations at the Smithsonian have been carried on for only twenty years, has been able to project these cycles back through occasional solar observations made since 1905 by the Smithsonian observers at Mt. Wilson, California, and through earlier ones made in New Haven, Copenhagen and Berlin. Thus his periodicity scheme has been checked through intervals covering more than a century.

In addition to the periods mentioned, Dr. Abbot has noted sequences of approximately 46 to 92 years which have had profound effects on precipitation, as noted, for example, by the level of Lake Huron. During the ten years following 1837 it fell 5 ft. Forty-eight years later Lake Huron began a similar, but not quite so great, ten-year fall, and then in 1929, or 92 years after the first recorded fall, there occurred another which almost exactly duplicated that of 1837. These 46- and 92-year cycles, he explained, are made up of two and four double sunspot cycles, each double sunspot cycle being 23 years.

"Although achieving moderate success in long-range forecasting by using the 23-year period and its multiples," said Dr. Abbot, "I have long hoped to get greater accuracy by building up forecasts from the effects of the individual solar periods." But the complexity of the earth and its atmosphere made this very difficult, he said, adding that "indeed the meteorologists have practically given up the use of periodicities because of unpredictable changes of phase in weather phenomenon."

But last December it occurred to Dr. Abbot that the changes of phase in weather might be caused by changes in season of the year, which, of course, are not dependent upon the sun itself but upon the movement of the earth around the sun. Since our 12-month year does not coincide exactly with any of the solar radiation cycles, obviously a point in a solar cycle does not fall on the same date every year.

"For instance," said Dr. Abbot, "if we are dealing with the 11¼ month period, its solar cause, if unchanging in phase, will gradually march in phase through all the months of the year. Only once in 15 years will it recur in the same relationship to the months of the year, that is, on the same date. May it not reasonably be that its effect on weather may

be different in January, when the northern hemisphere is blanketed with snow, and the atmospheric circulation is vigorous, from what its effect would be in the very different conditions prevailing in July ?"

Dr. Abbot tested this on nine stations scattered from Alaska to South Africa and is satisfied that the changes of solar radiation can be correlated with weather changes here on earth. Since each of the solar periodicities, whatever its length, has a certain least common multiple with respect to our 12-month year, it is possible to compute dates which occur at intervals of a certain number of years and upon which the weather effect of the given solar period should recur. The 8-month period recurs in the same phase every two years, since 24 months is a common multiple of 12 and 8.

As examples of long-range forecasting based upon these periods, Dr. Abbot said that he got a 71 per cent correlation on predicting the weather in Peoria, Illinois, for five years ahead, beginning in 1935. This, the best result thus far in a number of 5-year forecasts made for various stations, covers mean monthly values of the departures from normal precipitation. Two years ago, Dr. Abbot, at the request of Vice-President Garner, made a prediction of the precipitation for San Antonio, Texas, on the basis of the 23-year sunspot cycle, and very good results were achieved.

ELECTRICITY PROBLEMS IN GERMANY

It will have been noticed that the targets aimed at very frequently by the R.A.F. in Germany are electrical power stations. Two reasons for this are mentioned in an article in the *Electrician* of October 4. The first is that German industrial production, more than any other in Europe, depends on electricity, and the second that there is a great shortage of electricity due to the enormously increased demands for war production and to the exhaustion of reserves.

A few figures given demonstrate the problem which besets this part of Germany's war industry. In the year 1933, which witnessed the inception of the Nazi economy, the production of electricity was about 25,000 million kilowatt hours. Since then it has risen steadily to 36,000 million in 1935, 48,000 million in 1937, and finally 55,000 million in 1938. In 1939 still greater quantities were required, and it is unlikely that in 1940 the demand for electricity will decline. Two years ago, German experts pointed out that, owing to the special requirements for the production of substitutes and *Ersatz* articles, a consumption of some 100,000 million kwh. could be expected by 1943. This is twice as much as in 1938 and four times as much as in 1933.

As yet, no way has been found to meet these requirements. German experts themselves have left no room for doubt that the peak of production, determined by the availability of the plant, etc., has already long been reached. While the consumption of electricity increased twofold between 1933 and 1938, the productive capacity of electricity works increased only by about 12 per cent. This disproportion did not constitute a serious problem so long as there were enough reserves provided for in most of the gigantic electricity plants, built in Germany since 1918 with British and American capital. According to official statements dating as far back as the end of 1938, these reserves do not exist any longer. A report of the Reich commissioner of the power industry, who early last year was appointed by Goering to increase the production of electric power, disclosed that it was difficult to cover the industrial peak requirements for electricity in the winter of 1937–38. Since that time the problem has become more acute.

The reason for this shortage lies to a considerable extent in the increase in the production of synthetic materials, which require disproportionately large quantities of electricity. One single industrial undertaking producing such synthetic substances requires an electricity plant of some 100,000 kilowatts. From the following figures published at a meeting of the Association of Electrical Engineers in 1938, it is seen that the production of, for example, 1 ton of iron requires 100–200 kwh. ; copper, 300 kwh. ; synthetic rubber, 40,000 kwh. ; synthetic petrol, 3,000 kwh. ; textiles, 3,800 kwh. ; artificial silk, 7,000 kwh. ; aluminium, 20,000 kwh. ; and magnesium, 44,000 kwh.

Figures concerning the aluminium industry in Germany indicate that, so early as 1938, this branch produced 180,000 tons (which output is still far from satisfying Germany's war demands). The figure for magnesium was 100,000 tons, and the same quantity of synthetic rubber was also made. These substances, with synthetic petrol, which form only a part of the whole German *Ersatz* industry, require 20,000 million kwh., or two fifths of the whole 1938 consumption of power. This indicates to what extent German war production relies on electricity, and how a shortage or an interruption of electricity production is bound to hamper output.

Official estimates show that new plants of some 10 million kilowatts capacity have had to be built within a short period to meet these growing requirements. Construction on such a large scale has cost not only some 3,000–4,000 million Reichsmark, but also, a more important item, a great expenditure of time. One electricity plant cannot, in present circumstances, be constructed in less than four or five years, owing to the difficulties in the building industry and in the production of the required equipment. The shortage of skilled labour will increase these problems. The erection of power works which rely on water-power instead of steam would take still more time. For example, five years have been provided for the construction of only one part of the new electricity plant in the Tavern district of Austria which was planned shortly before the War.

Five sixths of the electricity works in Germany depend on coal, while only one sixth is water driven. Exports of British coal amounting to 20 million tons annually have now been completely stopped. Germany's iron industry alone will soon require a 30 per cent increase in coal, owing to the use of low-grade iron ores.

PROBLEMS ARISING FROM AN AGEING POPULATION*

By Dr. L. J. Dublin

AGEING of the American population—a result of a lengthening average life span and a declining birth-rate—is due to create serious social and economic problems for the future generations.

If we insist on lightening the burdens on ourselves by reducing the number of our children, we must be prepared to accept the consequences in terms of our social economy. We must be aware of the condition of life we are imposing on our children—namely, an obligation to care for a huge proportion of old people.

Since the beginning of the century, the birth-rate in the United States has decreased by more than one third. Immigration has been drastically cut, and during several recent years more people left the country than entered it. The mortality in the childhood ages is only a fifth of what it was three decades ago. It is these three factors which have shifted the population from youth towards the older ages. In 1850 there were 3,080,000 people in the United States who were sixty-five years of age or older, or 4·1 per cent of the population. To-day the figure is 8,418,000 or 6·3 per cent, and in 1980 it is expected to be 22,000,000, or 14·4 per cent.

In 1980, the birth-rate and death-rate are expected to meet—13 births and 13 deaths per 1,000 population—and thereafter the death-rate will be greater than the birth-rate, resulting in a declining population.

The bright side of the picture is in the improvement in death-rate. A century ago a little less than half the babies born in England and Wales were expected to reach the age of fifty. The situation was probably about the same in the United States. In 1938 four out of five male infants and five out of six female babies were expected to reach fifty. The chances of a new-born child reaching age sixty-five are to-day as great as the chances of reaching fifty were only thirty years ago, or about four out of five among white males and two out of three among white females. The continued improvements should ultimately enable three-quarters of the infants born to reach sixty-five.

A recent re-count of a group of persons born about 1876 shows that 20 per cent more lived to the age of fifty than were expected to at the time of their birth, which reflects improvement in medicine and in welfare conditions made during their lifetime; 30 per cent of those who to-day are sixty-five or older owe their survival to improvements of this kind made since they were born.

The improvements which have made this greater survival possible are reflected in the changed line-up of the leading causes of death, with tuberculosis, first in 1900, now reduced to seventh, and heart disease (an affliction mainly of the middle-aged and elderly) fourth in 1900, now elevated to first place. Cancer was the eighth ranking cause of death in 1900 and now it is second. Violence was sixth at the turn of the century and it is now third.

All this means that medical men will have an increasing number of heart and cancer patients and that measures must be intensified to hold these diseases in check. The number of blind and deaf is also due to increase, as will the number of those suffering from mental diseases.

* From a paper read on September 18 at the Bicentennial Conference, University of Pennsylvania.

FORTHCOMING EVENT

Friday, November 1

North-East Coast Institution of Engineers and Shipbuilders (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne) at 6 p.m.—Prof. W. M. Thornton: "Foundations of the Electrical and Mechanical Transmission of Energy" (Ninth Andrew Laing Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Resident Lecturer (Woman) in Geography—The Principal, Training College, Darlington (October 31).

Deputy Director of Education—The Director of Education, Education Office, South Parade, Nottingham (November 2).

Assistant, Grade III (Woman), at the Water Pollution Research Laboratory, Watford, Herts.—The Establishment Officer, Department of Scientific and Industrial Research, Teddington, Middx. (quoting J40/10) (November 4).

Assistant Bacteriologist in the Department of Preventive Medicine—The Registrar, The University, Bristol 8 (November 11).

Woman Lecturer in Education—The Principal, Saffron Walden Training College, Saffron Walden, Essex.

Lecturer in Geography and a Lecturer in Physics able to assist with Teaching of Mathematics—The Registrar, Municipal College, Portsmouth.

Graduate Master to teach Science in relation to Building and Engineering at the Beckenham Technical Institute—The District Secretary, Kent Education Committee, 12 Beckenham Road, Beckenham.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Rubber and Agriculture Series, Bulletin No. 14: A Method for the Application of Sodium Chlorate to Bracken. By Dr. G. H. Bates. Pp. 6. (London: British Rubber Publicity Association.) Free. [1010

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 4: Maxwell's and Dirac's Equations in the Expanding Universe. By Erwin Schrödinger. Pp. 25–48. 1s. Vol. 46, Section A, No. 5: Notes on the Electrochemistry of Gases. By K. G. Emeleus and Jean W. Beck. Pp. 49–64. 1s. Vol. 46, Section A, No. 6: Estimation of the Air-Earth Current. By P. J. Nolan. Pp. 65–76. 1s. Vol. 46, Section A, No. 7: The Equilibrium of Ionisation in the Lower Atmosphere. By J. J. Nolan. Pp. 77–90. 1s. Vol. 46, Section A, No. 8: Velocity Distributions in a Field of Force. By W. C. H. Eakin and W. H. McCrea. Pp. 91–102. 1s. Vol. 46, Section B, No. 4: River Liffey Survey, 3: The Growth and Food of Young Salmon. By Winifred E. Frost and Arthur E. J. Went. Pp. 53–80. 2s. Vol. 46, Section B, No. 5: Report on a Further Exploration (1929) of the Caves of Keshcorran, Co. Sligo. By A. M. Gwynn, F. T. Riley and A. W. Stelfox. Pp. 81–96. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [1410

Other Countries

U.S. Department of Commerce: National Bureau of Standards, Research Paper RP 1307: Influence of Cyclic Stress on Corrosion Pitting of Steels in Fresh Water, and Influence of Stress Corrosion on Fatigue Limits. By Dunlap J. McAdam, Jr., and Glenn W. Geil. Pp. 685–722+29 plates. (Washington, D.C.: Government Printing Office.) 10 cents. [810

Bulletin of the Raffles Museum, Singapore. No. 15: A Handlist of Malaysian Mammals; a Systematic List of the Mammals of the Malay Peninsula, Sumatra, Borneo and Java, including the Adjacent Small Islands. By Frederick Nutter Chasen. Pp. xx+209. (Singapore: Government Printing Office.) 5 dollars; 11s. 2d. [1010

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1939. By J. P. Mead. Pp. iv+100+4 plates. (Kuala Lumpur: Government Press.) 1 dollar; 2s. 4d. [1010

U.S. Office of Education: Federal Security Agency. Bulletin, 1939, No. 13: Conservation Excursions. By Effie G. Bathurst. Pp. vi+106. 15 cents. Bulletin, 1939, No. 14: Curriculum Content in Conservation for Elementary Schools. By Effie G. Bathurst. Pp. vi+80. 15 cents. (Washington, D.C.: Government Printing Office.) [1410

U.S. Department of Agriculture. Circular No. 561: Importation, Rearing and Colonization of Parasites of the Oriental Fruit Moth. By H. W. Allen, J. K. Holloway and G. J. Haeussler. Pp. 62. 10 cents. Technical Bulletin No. 702: Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics; Fourth Report. By K. T. Williams, H. W. Lakin and Horace G. Byers. Pp. 60. 10 cents. (Washington, D.C.: Government Printing Office.) [1410

NATURE

Vol. 146 SATURDAY, NOVEMBER 2, 1940 No. 3705

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Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
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Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 2, 1940 No. 3705

COLONIAL FORESTRY AND COUNTRYSIDE PROBLEMS

BUT a short while ago this heading would have been written in an inverse order, that is, countryside problems and forestry, the greater stress being laid on the former. In some matters, the British are ultra-conservative ; the more so perhaps where ignorance of a subject leads them to an instinctive opposition and disinclination to move in a, to them, unknown direction. In no department of administration has this national trait become more evident than the forestry departments throughout the Empire. India early broke loose from this official inertia, owing to a fortunate combination of clear-headed, wide-visioned Secretaries of State and competent Governors-General. The extensive, valuable and well-administered Indian forests are witness to this fact.

In the Colonial Forest Services, on the other hand, a very different position had gradually arisen. Forestry was completely misunderstood. It was thought that totally undeveloped areas of existing forests, supervised by small inadequate staffs, should pay their way almost from the start or they were not worth the trouble and expense of administration. The Secretary of State left matters to the individual and constantly changing Governors, who, with no knowledge of forestry principles, were for the most part guided by their financial advisers ; these latter regarded a forestry department merely as a potential source of revenue, the expenditure of which was ruthlessly cut when for various perfectly justifiable, in fact often obvious, reasons, the anticipated revenue was not forthcoming.

Although lip service had been given in expressions of opinion on the value of forests and their protection, etc., until well within the last decade there had been no real attempt at a continuity of management, with one or two notable exceptions, in the forestry services under the Colonial Office. An awakening had commenced and the present War appears to have hastened it.

The annual report of the Uganda Forest Department for the year ending December 31, 1939 (Entebbe, Govt. Printer, 1940) opens with a quotation from the Secretary of State for the Colonies (taken from "The Colonial Empire," Cmd. 6023, 1939) as follows : "Forestry Departments are becoming more and more involved in the study of general rural development and land use and contacts between them and other departments engaged on similar work have been strengthened."

In his introduction, the conservator of forests, Mr. N. V. Brasnett, who had been working closely with the director of the Geological Survey of the Protectorate, enunciates once again the time-honoured principles of a forest policy dealing with forest reservation ; obtaining the best financial return for the forest estate ; encouragement to private forestry, whether by native enterprise or private individuals ; and propaganda towards giving the people a knowledge of the value of forests both to themselves and to their posterity. There appears to be hope that Uganda, in spite of the War, will now be granted the facilities to put in force, practically, these articles of the forestry creed.

In the annual report of the Forestry Department for Nyasaland for the year ending December 31, 1939 (Zomba, Nyasaland, Govt. Printer, 1940) the Conservator, Mr. J. B. Clements, develops the same theme.

It is pointed out that the outbreak of War has enhanced the need for making the Protectorate independent of imported soft woods, and particular attention has been given to means of increasing the outturn of local timbers for building purposes, both hard wood and planted soft wood, in anticipation of increased demands. The village forest area scheme is providing a valuable reserve of poles and firewood near the villages themselves which did not exist a few years ago. This enables the urban natives to obtain these materials at low rates from forest reserves near the townships—a benefit now becoming appreciated by those responsible for the administration of improvident populations in tropical countries.

In the connexion here dealt with, the following depicts the new position as regards the forests, which is acquiring definite recognition. Alluding to a draft revision of forest legislation during the year, the Conservator says that the revision had become necessary for two reasons: (*a*) the change in status of various classes of land (native forest land) brought about by the Order in Council, 1936; and (*b*) the need for the gradual devolution of responsibility for forest protection and management to native authorities, and for their participation in a share of forest revenue. The Agronomic Sub-Committee of the Native Welfare Committee simultaneously put forward suggestions to Government for the enaction of legislation to implement soil conservation policy relating to all classes of land.

These proposals, together with those for the revised forest legislation, mark an important stage in efforts towards reform, and bring new emphasis on land conservation both as regards the selection of land for various purposes, and the conservative treatment of lands selected for agriculture and grazing. The land protection involved in forest policy, namely, the constitution of forest reserves in important catchment areas and watersheds, the closure to cultivation of steep hill slopes which in many cases become village forest areas, the enforcement of stream bank regulations, forms a really satisfactory nucleus for complete land planning in very many regions.

This encouraging departure, which in one form or another is making its appearance in other parts of Africa, will need the most careful supervision on the part of Governors, the civil administration and the Conservators, if it is to justify the high hopes which its introduction gives rise to. The education of populations accustomed from time immemorial to treat the forests as a property of no value will not be completed in a day.

CULTURE OF THE NUER

The Nuer

A Description of the Modes of Livelihood and Political Institutions of a Nilotic People. By Dr. E. E. Evans-Pritchard. Pp. xii + 271 + 30 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 17*s*. 6*d*. net.

To understand Dr. Evans-Pritchard's admirable account of the Nuer, a pastoral group inhabiting the swampy lowlands south of the junction of the Nile with the Sobat and Bahr el Ghazal, one must learn to think in terms of ox or cow (the ambiguity of these words in the English language showing how far we have degenerated in this respect). For it is explained that "their social idiom is a bovine idiom". Thus their difficult cattle terminology of colour, age and sex—the colour scheme is given us in a dozen striking diagrams—affords the chief clue to their marriage arrangements, ritual and law. Even kinship, that basic fact in the sociology of any primitive community, is customarily defined by reference to payments of cows in the form of dowries and other wedding-presents; so that "movements of cattle from kraal to kraal are equivalent to lines on a genealogical chart".

Thus this study by Dr. Evans-Pritchard, which is singularly successful in harmonizing a descriptive with an analytic interest, moves naturally forward from an examination of the ecology—that is, the economic life as determined by the physical conditions and state of the arts—to a review of the social organization as consisting in three complementary elements, the political system, the lineage system, and a peculiar system of 'age-sets', the sentimental bond uniting fellow initiates. The book, then, is remarkably compact, and the author is much to be commended for achieving so neat a

synthesis; even if it is only fair to allow some of the credit to the Nuer themselves for conceiving life as so well-rounded a sphere of functions and values.

Though he lays but little stress on the personal side of his experiences, the author could scarcely have enjoyed playing 'parasite of the cow', as every Nuer is only too happy to do, luxuriating not only in its milk, meat and blood, but in its more odoriferous products; so that animals and humans wallow in the same fetid and insect-haunted byre with that immunity to squeamish humours which precedes the evolution of the sanitary inspector. Nay, our veterinary experts would likewise be out of place here; for it is argued in some detail that, although the cattle-husbandry of the Nuer is in important respects out of keeping with our conventions of farming, their methods work well enough for them, and could not be altered without involving a fundamental change in their whole method of life. In fact, as so often, civilization in its most benevolent mood might easily make an end of their ancestral habits and of them together.

True, the Nuer are partly dependent on the cultivation of millet—though millet without milk strikes them as highly unpalatable; and are also handy at spearing fish. But it is not the nutritive so much as the social importance of the cow that ensures its pre-eminence in their vital economy. A man and his favourite beast become one in name, that is, for the primitive intelligence well-nigh one in soul; and the cow-name received at birth, and by which he was known to the playmates of his youth, will after death be handed down to posterity as if such an identification were a fuller expression of his inward being.

Another way of realizing how the culture of the Nuer is founded on one idea, one passion, is in the light of their saying: "it is cattle that destroy people". Not only among themselves do they indulge, as did our own ancestors, in the honourable sport of cattle-raiding, but this is the main cause of war with their neighbours, the Dinka, as also of trouble with the Government, the earlier methods of which indeed do not seem to have differentiated between cattle-raiding and tax-gathering as clearly as might be desirable. Feuds being composed by fines, blood-wealth, with bride-wealth rising and falling in harmony, provides the standard governing all commercial transactions, which are thus 'pecuniary' in the etymological sense. Indeed, to understand the political system in all its ramifications, it is sound policy to start from a blood feud involving in the first instance small agnatic groups. This thereupon creates an enmity spreading through a network of kinship ties, until the inter-relations of whole communities are influenced as they variously seek vengeance or arrange for compensation. All this militant clannishness makes for a spirit of dour independence and pride which the European visitor may easily resent as an ill-mannered truculence until he learns to understand their life and accept their values. It takes an anthropologist of Dr. Evans-Pritchard's insight and breadth of mind to do this; and therefore, if only because it is so fair to the facts, spiritual and material alike, does this book deserve to rank as a masterpiece of scientific interpretation.

R. R. Marett.

THE SCIENCE OF PLANT PROTECTION

The Scientific Principles of Plant Protection
With Special Reference to Chemical Control. By Dr. Hubert Martin. Third edition. Pp. x+385. (London: Edward Arnold and Co., 1940.) 22*s*. 6*d*. net.

THE need for methods of plant protection arises because, when plants are grown close together as a crop under favourable growth conditions, far greater opportunity is provided for the spread of pests. A fungus grown on a single plant has small chance of survival, but when there is a crop of many acres the conditions for the multiplication and spread of the fungus may render it a factor of primary and adverse importance.

Plant protection has become a science involving partnership between the biological sciences of entomology, mycology and plant physiology, and the physical sciences of chemistry and physics. Success involves their closest co-operation, for which an understanding of the scientific principles involved is essential: the book under notice seeks both to survey these as well as to provide a book of reference on insecticides and fungicides.

The methods of plant protection can be classified as preventive and curative. More or totally resistant varieties of the host plant may be selected and propagated; it may be protected by a chemical or by a combination of climatic and biological factors. The parasite may be destroyed on the seed or in the soil by a variety of methods. It may be attacked by toxic chemicals after its action on the plant has begun.

The greater part of the book is devoted to the

consideration of fungicides and insecticides. The chemical manufacturer is becoming more and more attracted to this field as an outlet for his products on the large scale, and an extension of chemotherapeutic knowledge is enabling a widely extended range of chemicals to be tried, not merely empirically, but as the result of the correlation of structure with toxicity. The physicist is at the same time learning to understand the theory and technique of spraying, dusting and fumigating with liquid, solid and gas. Hence he has been able to lead on to spreaders, stickers and emulsifying agents so as to promote the formation of the liquid/solid interface.

Fungicides are based on sulphur, copper, arsenic and fluorine compounds as well as on such organic substances as nicotine, pyrethrum, rotenone. Other materials are being tried in the laboratories, where a technique of measurement is being elaborated as a preliminary to establishing the connexion between toxic action and chemical constitution. Quite another class of chemicals serve as fumigants.

The magnitude of the subject will be apparent from the foregoing remarks. The author has in this third edition made good use of his earlier experience and produced an up-to-date and at the same time stimulating account of the subject. The research station at Long Ashton, from which the book is dated, can regard it as worthy of the scientific standing of the laboratory.

E. F. ARMSTRONG.

ELEMENTARY BIOLOGY

Intermediate Biology
By W. F. Wheeler. Pp. xiii+530. (London: William Heinemann, Ltd., 1940.) 15*s*.

THE remarkable development of biology in schools during the last decade has been accompanied by the inevitable spate of text-books which follow on the introduction of a new subject. The majority of the writers of these text-books have been stirred to produce works which would include cognate topics relating to the syllabuses of the various examining bodies. From the authors' points of view, it is a little unfortunate that the rapidity of the growth has been accompanied by the constant revision of examination syllabuses in biology, with the result that many of the books produced have quickly become unsuitable. Mr. Wheeler's book has been prepared to meet the demands of present-day students offering biology at higher school certificate, intermediate degree, pre-medical and allied examinations.

In the succinct accounts of the anatomy and embryology of the 'types' set in the plant and animals section of the various syllabuses, the author adheres rigidly to the standard of knowledge that might be expected of Intermediate students, the descriptive technique showing little advance on that in use some ten years ago. A useful innovation is the inclusion, at the end of some of the chapters on animal types, of a short section in which attention is focused upon the more important biological principles that the particular group illustrates. This feature could profitably have been extended to other parts of the book.

In other sections relating to the cellular structure and comparative physiology of organisms, the author has added a valuable contribution to the teaching of biology, as distinct from the daughter sciences of botany and zoology. The main biological principles are considered in terms of living organisms, plant and animal, adequate attention being devoted to the peculiar as well as the conforming types. Apart from the confused description of hormonal reactions in plants, these sections are clearly set out. The chapters on heredity, evolution and the relation of the organism to its environment are stereotyped, except for a concise description of the evolution of the vascular and urinogenital systems. The latter will probably be ineffective for the type of student for whom the book is intended, but, with a curtailment of detail, would perform useful service in any future edition.

The book is profusely illustrated, many of the diagrams having been taken from books already in use; the original figures are good, although, in contrast to some text-books in school biology which have been published recently, add little to established text-book illustration.

A real criticism of this, as of so many school biology books, is that the subject-matter is narrowly concentrated upon existing examination syllabuses. The need for this method of treatment is readily understood, but until writers of school text-books are prepared to include topics of wider interest to their pupils, examination syllabuses are likely to remain circumscribed.

This criticism is not intended in any way to detract from the usefulness of the book; it is eminently suitable for students preparing for the examinations mentioned above.

T. H. HAWKINS.

PROBLEMS OF NEUROHISTOLOGY

Problems of Nervous Anatomy
By Prof. J. Boeke. Pp. vii+164. (London: Oxford University Press, 1940.) 7*s*. 6*d*. net.

THE disadvantage of divorce between form and function in biological study is nowhere more often seen than in relation to the nervous system. Doubly valuable, therefore, is a review of some current problems by one of the foremost living neurohistologists who, while declaring that "however valuable physiological observations may be, as long as their real histological basis is disproportionately small or entirely missing, even the best physiological theories remain nebulous", is willing to admit that "morphological details everywhere only derive their full value in view of the physiological and functional insight which they are able to furnish".

The book is in four parts, based on as many lectures given in the latter part of 1937 in the Universities of London and Oxford and to the Anatomische Gesellschaft, with a bibliography which unfortunately does not include all names cited in the text. The first part deals with cutaneous innervation, and stresses the lack of a known structural basis for many clinical and experimental observations on cutaneous sensibility. Boeke rejects Head's view that two different kinds of nerve fibres are concerned with protopathic and epicritic sensation. In the light of recent histological, developmental and experimental studies, he suggests that protopathic sensation is the outcome of incompletely regenerated end-organs and as yet unmyelinated nerve fibres. He directs attention to the rich sympathetic plexus in the dermis, but the absence of all 'endings' in this plexus leads him to conclude that it is efferent in function.

In the next two parts the author develops a consideration of this "sympathetic ground plexus" in many parts of the body, and identifies the cellular elements in the plexus with the interstitial cells of Cajal. Boeke's review of the vexed question of the interstitial cells is one of the most useful things in his book. He thinks them to be of great phylogenetic significance in attempting to relate the vertebrate nervous system, with its highly organized cell patterns, to the simple nerve net of the lower invertebrates. This section was written before Prof. Woollard's last paper, in disproof of the invertebrate nerve net (Woollard and Harpman, *J. Anat.*, **73**; 1939). But Woollard's work, so sadly cut short, cannot be taken as conclusive, though it does imply that re-examination of the invertebrate nervous system is needed before further theoretical correlations are established. What neither the protagonists nor the antagonists of the nerve net seem to have considered is the relation between the "ground plexus" and the vascular system, which is undoubtedly retiform in its development and remains so in its periphery. Some of Boeke's own figures of the ground plexus strongly suggest a capillary relationship. How far is the one the trellis along which the other grows?

Several threads in the earlier sections are taken up in the last part, which is a review of the present state of the neurone doctrine in the light of modern physiological conceptions of the inter-neuronal synapse. It is a wise and thought-provoking chapter, which demands that out-worn concepts and conflicts be discarded so that fresh attacks can be made upon basic problems of neurology in the unhindered light of newer knowledge. Here, as elsewhere in the book, is evidence of the mature judgment, open mind, and breadth of vision of the man who has succeeded Cajal as the doyen of neurohistologists.

D. M. Blair.

NUTRITION IN WAR-TIME

Nutrition and the War
By Dr. Geoffrey Bourne. Pp. xii + 126. (Cambridge: At the University Press, 1940.) 3*s*. 6*d*. net.

IN Great Britain there has been, in the last few years, a great improvement in the national dietary which has been accompanied by a corresponding improvement in national health. The limit of improvement has not yet been reached. The increase in physical fitness of recruits drawn from the poorer class after a few months in the Army and of slum children evacuated to the country is an indication of the extent to which national health and physical fitness can be still further increased. All we have learned of nutrition in the last twenty-five years suggests that food is probably the most important factor in this improvement in physical fitness. The author of this little book gives some striking illustrations of the connexion between diet and physical fitness.

In the present struggle for our existence it is of the utmost importance to have the whole population in the highest possible state of physical fitness, upon which morale and fighting- and working-efficiency so largely depend. An important part of our war effort should be making the national diet fully adequate for health. At first sight, there would appear to be great difficulty in improving the national diet under present conditions when we are threatened with a shortage of some foods. Fortunately, however, it is possible to provide all the health factors from a few foods which we can produce in sufficient amounts at home.

The two most important 'protective' foods are milk, including dairy products, and vegetables, including potatoes. If consumption of these among the poor be brought up to the level among the well-to-do, we need have no fear of deterioration of the national diet in war. These foods should, therefore, receive priority in home-production. As the author of this little book points out, a reduction in the milk supply is likely to cause widespread ill-health, especially among children, whereas a reduction in the beef supply by even as much as 50 per cent would not necessarily be serious. There may be a great reduction in imported fruits, but this also need not be serious because all the nutrients of special value for health contained in fruit can be obtained from vegetables and potatoes. Fortunately, vegetables and potatoes are two of the crops which give the highest yield of food per acre, and the milk cow provides four or five times as much food for the feeding-stuffs consumed as the bullock. If our agricultural policy be based on nutritional needs, there is likely to be an increase in the production of these, even at the expense of less essential foods.

The Government may provide the food, but its efficient use depends on the housewife. The Ministry of Food is carrying out an extensive propaganda to bring the knowledge of nutrition to every household. This publication is designed to serve the same purpose. It deals mainly with the nature and composition of various foodstuffs. It gives the calorific value and an indication of the protein, vitamin and mineral content of a long list of foods. This will be of interest to the scientifically minded housewife. But, however much the experts may theorize about the perfect diet in terms of calories and vitamins, the well-to-do will continue to eat what they like and the poor to eat what they can get. The well-to-do are well fed. It is the poor who are ill-nourished. The problem of malnutrition is mainly an economic problem. Measures, such as the new milk scheme, which enables the poor to get milk for women and children at a reduced price, the allotment scheme, which provides cheap vegetables for families, and the placing of wholemeal bread on the market at the same price as white bread, are likely to do more to improve nutrition among the poor than technical instructions on food values.

AIR SURVEY

Air Photography Applied to Surveying
By Dr. C. A. Hart. Pp. xx + 366 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 25*s.* net.

No one could be better qualified than Dr. Hart to write this book, on the use of air photographs in the making of maps. Unfortunately for the advocates of this new method of surveying, they have had not only to amplify and perfect the instruments, the cameras and aeroplanes as well as the ground instruments, but they have also had to persuade the future users of the maps and surveyors that the resultant maps in many cases will be better in quality, quicker and cheaper in execution, and more accurate than maps made by older methods. Now when we consider the reasons for this rather curious state of affairs, we must attribute the blame fairly between the conservatism of surveyors and the over-statement of the merits of these air survey methods by some of the original advocates. There is, moreover, one other reason, and that is that this new method was left to commercial companies to develop, while heretofore it had always been Governments which had supplied maps. It was therefore often difficult for a man to realize that the sheet he could buy for 2*s.* 6*d.* had cost thousands of pounds to survey, and that the advocate was not only trying to sell him something, but also to sell something really good.

These points, and the original history and gradual introduction of air survey methods into the making of modern maps, are very clearly brought out in this book. Dr. Hart is not only a surveyor and therefore a maker of maps, but also, as an engineer, one of the users of maps. We therefore have both sides of the question fairly represented.

To the makers of maps we commend the technical chapters, which are full, accurate and clear; to the future users of maps who still may have a lurking

doubt as to the value of air photography as a sound method, we recommend the earlier chapters; and to the field surveyor we would add that ground survey will still remain as valuable and as necessary as ever.

The introduction of air photography, either vertical or oblique, is a somewhat similar epoch in the history of surveying as was the introduction of the plane table; only the older of us can remember the introduction of this instrument from India, and its rejection by many in England who preferred the chain and compass method.

Of late years the methods of air surveying have been greatly improved, and thanks are due to those like Cochrane-Patrick and others, who laid down their lives in the execution of air surveys, and to Kemp, Hemming and others who not only carried out surveys but also advocated and advertised their utility to a too often incredulous client. Air photography applied to surveying has come to stay.

Dr. Hart's book is a very good one, and Sir Alexander Gibb's foreword most appropriate.

C. H. D. R.

COKE AND ITS PROPERTIES

The Quality of Coke

Being the Second Report of the Midland Coke Research Committee, Iron and Steel Industrial Research Council. By Dr. R. A. Mott and Prof. R. V. Wheeler. Pp. xxxv + 464. (London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

THE literature on cokes until about twenty years ago concerned itself mainly with analytical information. Knowledge of their properties in use was mainly empirical, and to many important questions no answers could be given. In the meantime, a very large amount of experimental study has been devoted to the subject by research workers, and in Great Britain by committees established by producers and users of cokes. The Midland Coke Research Committee has issued two reports—the first in 1930—of work done under the direction of the late Prof. R. V. Wheeler and Dr. R. A. Mott. The second and present report was ready for issue just before Prof. Wheeler's death last year, and was his last publication.

Among common commercial products cokes are distinguished by a peculiar combination of qualities, the united effect of which determines their usefulness. These properties are both chemical and physical. Some are inherited from the parent coal and even when disguised by processes of manufacture are nevertheless detectable in the finished product. Thus raw coals are not homogeneous but possess a banded structure, evidence of which can be found in cokes. The properties of a coke can be influenced by conditions of carbonization and by treatment after manufacture. Again, even the densest coke contains 75 per cent of free space consisting of pores varying widely in size. All these properties combine to determine the behaviour of the product, which is normally consumed in lump form. Laboratory work, when, as is usual, made on samples in the form of fine particles, cannot take account of the differences due to size and structure of lump coke. This omission reduces the weight of the conclusions of many workers. Large-scale work is laborious and costly, but necessary to reveal the incidence of certain factors. It is the merit of the work in this report under notice that it is mainly about material in commercial form.

In the combustion of cokes, two chemical reactions are of primary importance: (*a*) the union of carbon with oxygen to form carbon dioxide and liberate the heat of combustion; and (*b*) the reaction of carbon with carbon dioxide in the fuel bed. Although at low temperatures cokes differ in their reactivities to oxygen, above a red heat the rate of reaction is so great that no differences can be measured. Rate of combustion is determined by rate of air supply, and differences in 'reactivity to oxygen' have no significance. At lower temperatures, differences can be measured and are significant in all those processes where a coke must attain or maintain combustion at temperatures up to a moderate red heat. This is generally the case in domestic grates, boilers and stoves burning at a low rate of combustion and usually in a small fuel bed. Under these conditions, the differences in chemical reactivity to oxygen between cokes of different origin and process are significant.

On the other hand, in industrial processes at high temperatures and in large fuel beds, the dominant factor is usually mechanical strength—resistance to 'shatter' and 'abrasion' in handling and movement during combustion. Anything that interferes with the free passage of gases through the fuel bed reduces the serviceability of the fuel. Indeed, chemical reactivity may accentuate this diminution by promoting the reaction of the carbon

with the carbon dioxide present in the fuel bed. By this reaction carbon is consumed with absorption of heat already liberated by the combustion of carbon with oxygen, and temperature rise is hindered. The manner in which these various factors are interwoven in different fuel processes forms the subject of the experimental work recorded in the report.

It should be mentioned that the Research Committee is interested primarily in the products of the large coke oven. Gas works coke, made to-day predominantly in continuous vertical retorts, has qualities which receive little prominence in the report. Nevertheless, it is the most comprehensive account of work on the qualities of cokes available in Great Britain, and is indispensable to all interested in this branch of technology.

H. J. Hodsman.

BUSINESS MANAGEMENT

(1) The Science of Production Organization
By Prof. E. H. Anderson and Prof. G. T. Schwenning. Pp. x + 282. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 17*s*. 6*d*. net.

(2) The Economics of Business Enterprise
By Prof. Walter Rautenstrauch. Pp. xiv + 446. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 20*s*. net.

BOTH these books are further contributions to the already extensive American literature on business management.

(1) The first, dealing with production organization, seeks to gather up and correlate recent writings on the subject, to smooth out and reconcile apparent contradictions, and to point the true path to further progress. There are doubtless still many who regard the extreme analysis of business methods and the more advanced tenets of scientific management with some distaste, not to say great aversion; but whilst industry and trade remain largely on a competitive basis—and possibly still more so if they were on some other basis—it appears to be a primary need to seek out the best and most effective methods of running a business. This necessarily involves a close study of the science of organization, and the book before us gives, lucidly and concisely, within the comparatively short compass of some 250 pages, much of the best of recent American thought in this field.

After a preliminary clearing up of definitions, the authors deal with the growth of organization ideas from the time of Adam Smith; the organization of work; organization structure; types of organization-line, line-staff, functional, and committee; comparison of these; principles and laws; and broader aspects. The analytical mind at least will probably study with some interest the discussion of Gilbreth's 'therblig', the unit of human effort which F. W. Taylor had sought for in vain. There are at present eighteen of these, with promise of more to come, and the authors think the 'therblig' is destined to become a standard unit of manual productivity and possibly of labour cost. A fairly extensive and carefully selected bibliography is appended.

(2) The second work is rather more formidable—more than four hundred pages and a longer bibliography—and yet its modest aim is merely to serve as an introductory text on *some* economic problems of business enterprise. It is also much more concrete in that its chief pre-occupation is with practical methods for dealing with such things as cost estimating, interest and depreciation, evaluation of machines, materials and supplies, interpretation of financial statements, together with an interesting discussion of business enterprise in general illustrated with valuable examples of actual American businesses taken from a wide range of industry. Another admirable feature which gives a welcome realistic touch and a satisfying method of grasping the subject-matter is the addition of problems at the end of each chapter. There are numerous tables and a certain amount of fairly easy mathematics.

Costing and accounts executives who wish to add to the basic knowledge underlying their particular fields of action will find much of interest and value. Prof. Rautenstrauch certainly seems to have done a good piece of work, something more than an introductory study, and has adequately fulfilled his purpose of "stating what is generally considered to be good practice in dealing with the economic problems of specific business enterprise, inquiring into theories on which these practices rest, and developing methods of analysis" for dealing intelligently with the economic problems of a given business. But although he goes very thoroughly into the questions of costing, he does not seem to worry much about the 'therblig'.

ECONOMIC RESOURCES AND THEIR EMPLOYMENT*

By Dr. Wesley C. Mitchell,

Director, National Bureau of Economics Research, New York

THE most important resource available to man is knowledge, for the materials and forces in his environment become useful to him only as he learns about them, and through science and technology converts them to his needs. In view of this fact, any denial of the right to follow the truth wherever it leads will assuredly hamper the future growth of science and so dim humanity's prospects. To-day, the widespread recognition of the fundamental importance of study and research to society is indicated by the huge sums and vast amount of energy invested in schooling and development of new techniques.

Essential, then, is the task of conserving for future generations these resources, lately become precious because of autocratic pressure in various quarters of the globe. Knowledge is power; it holds the key to all other resources and the better way of life which all men are seeking. Those democracies still existing must examine to what extent they are prepared to defend their right to gain knowledge. Scientific research, more than any other type of activity, requires freedom. The man who makes discoveries must be free to ask sceptical questions. Dogmas have ever been the foe of science, and science the destroyer of dogmas.

The modern classification of resources made by economic theorists is essentially that devised by Ricardo more than a century ago, with a few modifications. Whereas Ricardo thought of the annual produce of society as being divided into rent, wages and profits, to-day we think of interest as distinguished from profits and capital as distinguished from business administration. In our day most people get their living by making and spending money incomes, making it obvious that the processes of producing and distributing wealth have become interdependent.

The development of man's most important resources has enabled him to command innumerable natural forces and convert to domestic use many things which at one time in history were dangerous. The process, of course, started ages before records were kept, and the triumphs of science since the days of Galileo and Dalton have covered so wide a range, and have yielded so many practical applications, that we have acquired an almost mystical faith in its ability ultimately to solve the problems that still baffle us—provided we do not stop the process of discovery by using the present powers of science to destroy ourselves and our culture.

Study of the development and utilization of the economic resources in our culture, however, gives no reason for believing that the form of economic organization influences the occurrence of scientific genius. Certainly some of the great early discoveries came from economically backward countries—for example, Copernicus from Poland, Galileo from Italy, Descartes from the *ancien régime* in France, Leibniz from cameralistic Germany. But I do think that capitalism provides conditions far more favourable to the practical application of scientific discoveries and the work of the world than the economic forms it has gradually displaced. While capitalism nurtured the Industrial Revolution, it is true also that the Industrial Revolution has in turn fostered science. An excellent example of this is to be seen in the great assistance given to biologists, anthropologists, geophysicists, meteorologists, and by rapidly expanding world trade. Slowly but surely, business men are learning the value of research for their particular needs.

But this alliance between research and business developed latent incompatibilities between the temperaments of the two. Business enterprises have uses for science in so far as it promotes their pecuniary aims. They maintain research staffs to study their problems, but do so chiefly with the expectation of keeping newly discovered ideas in reserve until business conditions make their use expedient. In many an American corporation tension has developed between the engineering staff interested in technological perfection and the financial executives interested in profits. This gives evidence that our economic organization, in spite of its prodigious efficiency in comparison with the forms it has superseded, still fails to make full use of the resources at its command. This is true even at times of greatest expansion. A great increase in the output of useful goods—no one can say how great—might be effected if we employed our basic resources of knowledge to the full.

Even though we do not make full use of our economic resources, we are nevertheless using

* Substance of an address given on September 17 at the Bicentennial Conference of the University of Pennsylvania.

up certain of them at a rate that rouses grave apprehension as to the future. Forests are disappearing, valuable soils are being eroded, animal species are being exterminated, and coal, petroleum, natural gas, and mineral ores are being used in prodigious quantities. If these inroads upon Nature's cupboard continue to grow for a few generations, the cupboard will be bare of many treasures that have become almost indispensable to our culture.

Books have been written on the problems created by large-scale industry, recurrent business-cycles, giant monopolies, waste of natural resources, etc.; but underlying all these problems our economic difficulties are a result, primarily, of an uneven growth in different parts of man's knowledge.

One group of sciences which, compared to the natural sciences, has not yet reached adolescence, is the social sciences. Many more benefits might have accrued to society from its rapidly increasing mastery of Nature had not the progress of discoveries and applications of the social sciences lagged behind those of the natural sciences. The explanation of this lag is apparent. The social scientist deals with man—a far more complex being than the materials with which the natural scientists deal. He is variable to responses to given situations and is far less susceptible to control by an investigator. Social inventors likewise have an excuse for their paucity of gifts to mankind. The social inventor does not have a large body of precise tested knowledge to draw from; seldom does he have the opportunity for extended and methodical experiment. Unless money is to be made, society is indifferent. Quite often governmental action is necessary before a trial can be made. In this connexion, the necessity for a changed social point of view to expedite the lagging progress of the social sciences has been employed.

The hesitant progress of the social scientists and social inventors does not indicate that all hope of progress has gone. Undoubtedly advances in knowledge of human behaviour have been many since the time of Adam Smith. Many data concerning individual social behaviour have been assembled and classified. Social inventions have been made also, for example, the limited liability of stockholders, cartels, chain stores, birth control, social insurance and the parole system.

If our inability to make full use of our other resources is due in large measure to maladjustments among economic processes, and if economics has developed methods that promise to make it more applicable to actual conditions, then enlightened citizens should do all they can to promote social research in general and economic research in particular.

Of course, no certain returns can be guaranteed upon research of any type, but a success here and there may repay many times over not only the direct costs of the successes themselves but also the cost of numerous failures. For example, the many millions of dollars per business-cycle that society would gain from a mitigation of cyclical contractions would justify investing some millions in trying to find out how the flows of products, incomes and purchases can be kept better balanced. To gain a billion it is mathematically worth while risking a million, if the chances of success are more than one in a thousand. A nation whose current annual income is estimated at seventy thousand millions would be wise to accept the odds.

Since the day of the French physiocrats and Adam Smith, economics has breathed the breath of freedom. The autocracies' way of using resources to aggrandize the State is a serious threat. Admitting certain immediate benefits to be derived from the totalitarian form of government, it is still difficult to believe that this demonstrates that autocracy is more efficient than democracy in satisfying the wants of its citizens. Of course, if these citizens have been brought to the point of preferring their individual shares in military triumphs to "life, liberty and the pursuit of happiness", they must be satisfied for the time being. For this military gratification, they are paying a heavy price in the severe sacrifices which are imposed upon them in their daily lives.

All of us realize that democracy is far from perfect, but we prefer it infinitely to a system under which compulsion rules. Our economic organization works out results that satisfy no one; but with all its faults it produces a higher standard of living at the cost of less effort than any autocracy has shown.

The present world conflict does not demonstrate conclusively that autocracy confers great military power upon a nation in the long run. All that is clear is that a heavily armed nation governed by a single will is for a while more than a match for nations that have neglected their defences materially and morally. But since war depletes irreplaceable natural resources with utter recklessness, there is more than ever a need to cultivate the one great resource that can be increased and through its increase made to open other resources, namely, scientific research; and since scientific research requires freedom, in defending freedom we are also protecting the future of mankind from a deadly menace.

The real strength or weakness of democratic institutions in meeting autocratic aggression will be shown by the intelligence and the wholeheartedness with which the peoples who cherish individual liberty behave in the next year or two.

MEDICINE IN WAR-TIME

By Prof. J. R. Marrack,
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Some twenty years have passed since the Medical Research Council published a Medical Supplement to the War Office *Daily Review of the Foreign Press*. In those twenty years the foundations of medicine have been widely extended, the methods of medicine have continued to shift from treatment towards prevention and, particularly in the last few years, the general outlook of men of science has changed from a detached aloofness towards active participation in the solution of social problems. Supposing that a medical man of 1918 had slept from then to now and woke up to read the first number of the new *Bulletin of War Medicine*, issued by the Medical Research Council (see p. 585 of this issue), what evidence would he find of the progress of medical knowledge and of a wider outlook ?

He would find that the treatment of wounds is still considered the most important task of medicine in war and that, as in 1918, great interest is taken in the chemotherapy of infections. Sulphanilamide, the compound recommended, is new—that he would expect ; but he would not realize, from the articles abstracted, how much more effective sulphanilamide and allied compounds are than previous chemotherapeutic agents. If he were a research worker he would be humbled when he learned the history of the discovery of sulphanilamide. For years now, patient research has been made into the nature of the specific protection given by antisera. We have learned much about the relation of such specific reactions to chemical structure. It might reasonably have been hoped that this type of research might lead to the discovery of specific therapeutic agents—the converse of Goebel's preparation of specific protecting sera by the use of synthetic antigens. Actually, the sulphanilamide compounds, which have revolutionized the treatment of septic infections, were discovered by the method of trial and error.

'Dr. 1918' might console himself by another advance in the treatment of wounds. He would find abstracts of three papers which deal with the source of infection of wounds. These are the fruit of straightforward research, particularly on streptococcal infection after childbirth. Some women carry hæmolytic streptococci in the vagina ; but it was generally agreed that these women were not particularly liable to puerperal sepsis. It was necessary to look for some source of infection outside, but it was difficult to incriminate the real source of infection, for streptococci are as widely distributed as pound notes. It is not possible to find whence a person got a pound note unless it is marked.

It has, of course, long been realized that there were many types of streptococci ; but the methods of identification presented peculiar difficulties. Now that these difficulties have been overcome and more than twenty-four distinct types of streptococci are recognized, the streptococci are 'marked'. If a streptococcus of the same type as that causing puerperal sepsis is found in the nose or throat of a person in contact with the patient, it is highly probable that this person is the source of her infection. In one series studied about six years ago the infection in 57 per cent of the cases was traced to the throat or nose of persons in contact with the patient.

This method has been applied to other infections, and the writers quoted in the *Bulletin* conclude that infection with pyogenic cocci does not usually occur when a man is wounded, but is derived from the nose or throat of an attendant or the dust of septic wards. 'Dr. 1918' might remember that, when he was admitted to a base hospital in 1917 with streptococcal tonsillitis, the man in the next bed to his had had his leg amputated at the knee ; and that the ward sister took a special pride in herself stirring up the dust of the ward with a duster, collecting at the same time a small fraction of the dust on the duster. We might conceal from him, for a time, that there are still civilian hospitals that do not use vacuum cleaners.

In the work on the treatment of shock, 'Dr. 1918' would find a direct continuation of the research and advances made during the War of 1914–18. It was then realized that some of the symptoms of shock were due to loss of fluid from the blood to the tissues and that any effective treatment must restore the blood volume. If salt solution was injected, to replace lost fluid, it also quickly escaped from the vessels. What was needed was a solution of some substance of high molecular weight, which, like the proteins of plasma, would not diffuse readily from the blood vessels and might even, owing to its osmotic pressure, suck fluid back from the tissues. Foreign proteins could not be used

and human plasma proteins could not then be obtained. The obvious fluid to be used, then, was blood, although the concentration of corpuscles in a shocked patient's blood was high already (and adding more corpuscles might make matters worse, if more fluid from the injected blood was lost). Besides, blood for transfusion could not always be obtained. Solutions of gum acacia, with an osmotic pressure equal to that of plasma protein, were tried, but were not satisfactory. Attempts were made to preserve blood, but these were not successful. So for years transfusion of blood from a donor, fetched for the occasion, was used ; the only advances were in details of technique and in the organization of donors.

When the rebellion started in Spain in 1936 the Catalan authorities, partly inspired by the use of cadaver blood in the U.S.S.R., organized a service of stored blood. It was found that blood could be used two weeks after it was collected. Transfusion with fresh or stored blood came to be used much more freely than before. When stories of the use of stored blood first reached Great Britain they were received with scepticism ; but, as medical men who had been attached to the Government medical service returned and gave detailed accounts, the value of the method, particularly in war, was recognized. When the War broke out large amounts of blood were collected in readiness for a heavy demand ; as these stores became unfit for use, they were thrown away and fresh supplies obtained. Blood was wasted and donors became reluctant to give their blood merely in order that it might be poured down the drain.

However, only the red corpuscles of the blood deteriorated in a few weeks ; the plasma proteins remained as good as ever. Early this year it was realized that even when the whole blood was unfit for transfusion, the plasma could be drawn off and used. A few years ago American physicians had started to treat the œdema of certain forms of kidney disease with concentrated human serum, which had been made by evaporating serum and redissolving in a small volume. The dropsy is due to the low concentration of protein in the plasma of these patients, and by this means the concentration of protein was raised and the œdema cured. This suggested a much better way of keeping and using the surplus plasma. When dried it was convenient to store, it could be redissolved in a small volume and be used to raise the concentration of large molecules in a patient's plasma, not with a foreign substance, but with the natural protein.

It is now found to be simpler to collect blood solely for the purpose of making dried protein, to let it clot and use the serum instead of plasma. Dried serum and plasma are now being prepared on a large scale. The product is a waxy-looking solid that dissolves readily ; it can be kept indefinitely at room temperature ; when required for use, sufficient water is added to make up the concentration required. It seems possible that dried serum will replace blood in the treatment of shock.

All this appears obvious, but behind it lies research work that may be said to begin with the preparation of dried proteins in a soluble form by Hardy and Gardner, and includes the studies of the relation of plasma proteins to dropsy. It has had the support of the great increase of knowledge of the physical chemistry of proteins, particularly that obtained by the ultracentrifuge methods of Svedberg.

There is little, however, in these achievements that the medical man of 1918 might not have anticipated. But the recommendation in several of the papers of corticosterone or desoxy corticosterone for the treatment of shock is something that is entirely new ; here, and in the paper by Mottram on "Diet in Wartime", we get hints of the great gap that lies between 1918 and 1940, of the great advance in knowledge of the working of the body.

The sterones of the adrenal cortex recall the work on endocrines—the discovery of insulin, the unravelling of the sex hormones, the separation of the various hormones of the anterior pituitary, the explanation of the action of the parathyroids, all of which have come since 1918. In 1918 adrenalin was the only hormone the structure of which was known ; thyroxin had been isolated in crystalline form, but its true structure was not settled until about ten years later. Cholesterol was then an alcohol of high molecular weight ; fragments only of its structure were known. The question of this structure was not settled until 1932 ; and new methods of investigation, X-ray analysis and the measurement of surface films helped in the solution of the problem. Now a whole series of sex hormones, the hormones of the adrenal cortex, the precursors of the D vitamins and the aglucone fraction of the cardiac glucosides, are known to have the same skeleton as cholesterol. Their structures have been established and some have been synthesized.

'Dr. 1918' knew of three vitamins, fat-soluble A, water-soluble B and the antiscorbutic vitamin. The amounts in various foods were represented by one or more plus signs. Now the amounts in food and the requirements of human beings can be given quantitatively. As with hormones, the chemist seems suddenly to have mastered the difficulties of isolating vitamins in a pure form and of analysing their structure. The structures of nine have been discovered within the last ten years ; seven have

been made artificially; three and a substitute for a fourth are made on a commercial scale.

The practical importance of this fourth, vitamin K, is a story of the last three years. It has been known since 1934 that the blood of chicks, the food of which did not contain this vitamin, clotted very slowly. The reason for this delay is deficiency of prothrombin—one of the normal constituents of blood plasma which is a factor in causing clotting. The amount of this factor in plasma is reduced in liver disease also; partly because bile, secreted by the liver, is necessary for the absorption of vitamin K, without which men, like chicks, cannot make prothrombin, partly because the diseased liver may not be able to make prothrombin even when sufficient vitamin K is absorbed. Because the blood did not clot, bleeding was one of the dangers of operations on patients with diseases of the liver. It is now possible to increase the prothrombin in plasma, so that the blood clots normally, by giving vitamin K and bile; provided, that is, that the liver is not so badly damaged that it cannot manufacture prothrombin. The natural vitamin, the structure of which was discovered in 1939, has a naphthoquinone nucleus with a long phytyl tail. Fortunately, synthetic compounds, without the tail, are equally effective. They are now used in treatment of patients with liver diseases, and of new-born babies with a tendency to bleed, due, also, to deficiency of prothrombin.

It is now generally accepted that vitamin B_1 forms a coenzyme that is required in the intermediate metabolism of carbohydrates in the brain; and it has recently been realized that the two vitamins, nicotinic acid and riboflavin, are embodied into compounds that act as carriers of oxygen for the oxidation of glucose. The part that these three vitamins play in the economy of the body is now settled. Here is the great difference between 1918 and 1940; in place of vague principles in some way necessary to health, we have substances of known chemical constitution which we can measure, the function of which in the working of the body we are beginning to understand.

Half the *Bulletin* is devoted to the treatment of wounds. But if the methods recommended reduced the morbidity of wounds by three quarters, they would make little difference to the issue of the War. The matters that concern medical men and that may have a decisive influence on the course of the War are preventive, namely, proper protection against air attack and the maintenance of nutrition. There is little in the *Bulletin* about either; this is due in part, of course, to the selection of papers for abstraction.

We know how much lack of food was responsible for the collapse of Germany in 1918. Both to keep our health and to sustain the maximum effort for victory we must plan our limited resources to the best advantage, and people must know how to make the best use of the food that they can get. Yet only one paper on food in war is included in the *Bulletin*. Several other valuable papers have appeared during the last year which might have been included. Yet there has been pitifully little discussion and criticism of the Government's food policy. Food is a matter of which we all know something; general practitioners, in particular, are in a good position to know about people's mistakes and wishes. Why have they not written more?

If proper protection from air attack is not soon provided, it will be difficult to maintain the production of munitions (which is not a medical matter) and the will to continue the War (which is). We have already signs of the epidemics which will attack us if the overcrowding in shelters and sanitation is not improved. It may already be too late.

One paper only in the *Bulletin* can be said to deal in any way with the protection of civilians. The abstractor is able to point out that this matter is treated excellently in the A.R.P. handbook. But what about the subjects that are not treated well in official publications? Have there been no suitable papers at least on the organization of the collection and treatment of air-raid casualties?

But the editors can take only a fraction of the blame. All people with any trace of scientific training must have realized the futility of the so-called gas-proof room, which, for years, was the form of protection recommended by the A.R.P. authorities. Yet how many individuals or organizations of men of science made any protest against this bluff; and when the A.R.P. authorities did start on real protection, how many demanded that shelters should be sufficient, sanitary—and in time?

Think how freely and vigorously the Food (War) Committee of the Royal Society criticized the Government in the War of 1914–18 and how big a part it played in shaping a sound food policy. How different our situation might be to-day if the Royal Society had appointed an A.R.P. Committee some years ago. Only an independent body can make the necessary criticism; Government advisers are too tied by loyalty and caution.

Perhaps we might find it difficult to convince 'Dr. 1918' that men of science are turning towards a more active participation in the solution of social problems.

"Curse ye Meroz, curse ye bitterly the inhabitants thereof, because they came not to the help of the Lord, to the help of the Lord against the mighty."

THE SCIENCE OF RHEOLOGY

By V. G. W. Harrison,
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THE word 'rheology' was coined in the United States in 1929 to denote the science of the deformation and flow of matter. Though the name is new, the science itself is old, and man has had a practical knowledge of some of the main facts of rheology since very early times. The phrase "rheological phenomena" may sound learned and forbidding; yet we study these "phenomena" every time we spread butter over bread with a knife, grease a motor-car, paint a garden shed or 'help' children make sand castles. If it be of any advantage to man to improve bread, butter, cheese, jam, chocolate, inks, paints, varnishes, textiles, building materials and a host of other everyday commodities—without which civilization as we know it could not exist—then the study of rheology needs no further justification.

It would be impossible to say who was the first rheologist. The discovery of facts so intimately connected with our daily life and associated with the very foundation of civilization was probably made gradually and by many people at about the same period. Some of the earliest handwork of man has been pottery. Pottery is made from material which is sufficiently plastic to be moulded in the hands, but retains its shape when left untouched; it must also dry out to form a rigid, hard substance. One can well imagine the early potters making experiments with various natural clays which they found; they were conducting a piece of rheological research of the first importance.

Coming to more recent times, we find Lucretius wondering why olive oil flows less readily than wine, and making theories to explain this fact not essentially different from those we hold to-day. To Heraclitus came the idea that "everything flows". Despite this good beginning, however, it must be admitted that to-day rheology, as a science, is still in its infancy, and it has received far less attention from scientific men than it deserves. Rheological research is, however, now making rapid progress, since it has been found indispensable in many industries, and it is my purpose here to describe some of the facts which have come to light, and to show how they can be used for the solution of practical problems.

The Three States of Matter

Nature is immeasurably complex, and in the early stages of learning it is a great help to classify and simplify the various facts with which we are faced. Such classifications and simplifications serve, so to speak, as pegs on which to hang our knowledge where we can see it conveniently, but, while undoubtedly useful, it must be remembered that they are man's creation and Nature herself pays scant attention to them. Thus, sooner or later, our knowledge reaches a stage when we become aware of facts which do not fit in with our artificial scheme—the classification breaks down, and we either have no "peg" on which to "hang" our fact, or, worse still, the fact looks as if it ought to be "hung" on two or three "pegs" at once and yet fits properly on none of them.

In our early days we recognize three well-defined states of matter: solids, liquids and gases. By applying heat, solids melt and become liquids, and liquids boil and become vapours or gases. Similarly, by cooling, gases can be condensed to form liquids and finally frozen into solids. The melting and boiling points are sharp and well-defined temperatures. Water is a perfect example: it freezes into ice at 32° F. and boils to form steam at 212° F.; at 32° F. you can have ice crystals and water mixed, but you cannot have an intermediate pasty substance neither ice nor water.

It is not possible to give here scientific definitions of solids, liquids and gases, but their general properties are well known. Solids are characterized by a definite shape, and other solids cannot pass through them—they can only break them. The shape of solids can be altered to some extent by the application of forces, but as soon as these forces are removed, the solid tends to return to its original shape. This characteristic behaviour is known as *elasticity*. Liquids, on the other hand, have no elasticity in this sense. They have no definite shape and solids can pass through them, though solids meet with some resistance when in motion through fluids—this is called *viscosity*. Thus glycerine is more viscous (that is, less fluid) than water. Elasticity is a property characteristic of solids, and viscosity one characteristic of liquids.

So far so good. But on further examination one finds that the distinction between solids and

liquids is in some cases not so clear. For example, some materials, such as glass, have no definite melting point, but become pasty over a fairly wide range of temperature before they finally melt; in other words, the transition from solid to liquid seems to be not sharp but gradual. When they are in the pasty state, are they to be regarded as solids or liquids? There is a certain kind of marble which, when examined over a period of a few hours, appears to be a typical solid; nevertheless, over a number of years it is found to flow like a liquid. Is it solid or liquid? The older chemist used to evade such awkward questions by saying that such materials were "not pure"; however, be they pure or not, many of them are of the greatest importance in daily life, and it is the duty of the rheologist to examine their properties. One meets with surprisingly few chemically pure substances outside the laboratory.

Some of the most characteristically solid materials we possess are the metals, yet even these can, in certain circumstances, show some of the properties of liquids. An example will make this clearer. A steel wire suspended at one end from a beam in the ceiling can be overloaded so that increase in length is no longer proportional to increase in load and the wire no longer regains its original length when the load is removed: in this state engineers say that it has received a 'permanent set'. If the wire is greatly overloaded, it will be found to stretch visibly over a period of time before it breaks, and in this state it is really flowing like a liquid. The extension due to flow is many times greater than that due to true elasticity and it does not take place instantaneously. These quasi-liquid properties are of great importance from the engineer's point of view, since without them the forging and cold working of metals would be impossible. They are a mixed blessing, however, since some materials can show slight flow over a long period of time even when they are not overloaded, and such 'creep' can prove troublesome.

There is yet another effect of overloading which deserves mention. An overloaded wire is harder than the original metal was. This 'strain hardening' is familiar to the engineer; but it may be surprising to find that it occurs also with butter and cheese. Another form of overloading occurs also when metals are polished. Very high stresses are set up at the surface during the polishing operation, and the surface layers of the metal flow like a liquid; consequently the polished surface has a different structure from that of the body metal.

In certain circumstances liquids can behave in ways characteristic of solids. This is especially true of liquids of very high viscosity. For example, some bitumens are true liquids, but under ordinary conditions they flow so slowly that the movement is noticeable only after a long period, probably many days. Consequently, they can be cut like a solid. Pieces so cut will not retain their shape indefinitely, but for short periods of time they can be treated almost as solids. They even show a form of elasticity. If they are deformed by the application of a force and the force is removed after a short time, many of them will slowly recover their original shape; if, however, the force remains applied over a long period, the deformation is permanent. Certain other liquids show a form of 'flow elasticity'. If they are flowing through a narrow tube and the supply of liquid is suddenly cut off, not only does the flow from the end of the tube cease abruptly, but also the liquid actually recedes into the tube a little way.

Plastic Materials

The materials so far examined have all been predominantly solid or liquid in character. There are, however, many materials in which solid and liquid characteristics are about evenly balanced, so that it is impossible to decide whether they are to be regarded as solids or liquids. These are said to be 'plastic', and are to be distinguished from the 'plastics', such as bakelite, which are now widely used as constructional materials in industry. True plastics have the appearance of solids and if left undisturbed they will retain their shape indefinitely. If they are subjected to a small force, they deform elastically like a solid and recover their shape (though not necessarily instantaneously) when the force is removed. Should the force, however, be increased past a certain critical value, often called the 'yield value', they flow continuously like a liquid. Consequently, plastics can easily be moulded to any desired shape and will retain that shape as long as they are left undisturbed. Potters' clay is a typical plastic. It is only because clay has these rheological properties that the making of pottery is possible.

Another familiar material which has both solid and liquid properties is flour dough. This behaves in many ways like a viscous liquid, yet it shows partial elastic recovery if a force is applied to it and removed after a short time. The recovery is not complete and it takes place gradually, so that the dough has a definite 'recovery time'. The rheological properties of dough are particularly important, since if these are unsuitable, it is impossible to make a good loaf. The properties of doughs have, therefore, been studied extensively by rheologists, and it has already been found that the addition of small quantities of certain substances, such as cystine, to the dough improve its working qualities.

'Non-Newtonian' Liquids

There is another property of certain materials which deserves mention. With true liquids, such as water, the viscosity is not altered by stirring; these are known as 'Newtonian liquids'. There are, however, many 'non-Newtonian' liquids, the viscosity of which is affected by stirring, and these are of considerable practical importance. This behaviour is known as 'thixotropy', and is well shown by the clay bentonite when mixed with water. When mixed in the right proportions, this sets to a firm jelly which is easily liquefied by stirring or shaking. When left undisturbed, the liquefied jelly soon re-sets. Similar behaviour is shown by many apparently viscous liquids which lose their 'body' on stirring, only to regain it as soon as they are left to settle down. For example, printing inks appear, in the tin, to be either thick liquids or solids—some have actually to be cut out of the tin with a knife. They rapidly become quite fluid on the machine, however, on account of the stirring and shaking they receive, and they can thus be distributed over the rollers to the printing block without any difficulty. Once the ink is transferred to paper, it re-sets. This behaviour is important, since inks normally take several hours to dry hard, and the initial 'thixotropic setting' helps to reduce the tendency of the wet print to smudge.

Similar to printing inks in many respects are artists' oil colours. These can be spread easily by a brush, but the colour sets rapidly as soon as the brush has left it, so that most of the brush marks are retained, giving the characteristic appearance of an oil painting. Paints are thixotropic, and they have to be so prepared that the mixture sets sufficiently slowly to allow the brush marks to flow out, but sufficiently quickly to prevent the paint from running down sloping surfaces. Heather honey, unlike honey from all other European floral sources, is also thixotropic. At rest, its viscosity is high, so that air bubbles within it are entrapped and prevented from rising to the surface; the viscosity drops on stirring, so that the honey can be spread easily by a knife. Much the same is true of butter and cheese, toothpaste and shaving soap lather.

There is another class of non-Newtonian liquid, in which the viscosity *rises* on stirring. An excellent example is a suspension of rice starch in water. This can be prepared so as to appear of the consistency of cream, when tested by gently tilting the containing vessel. The mixture can be stirred slowly without trouble. The more rapidly one attempts to stir it, however, the stiffer it becomes, and it appears to be impossible to stir it at more than a certain rate, no matter how much force is applied to the stirrer. Still more remarkable: a small quantity can be poured into the palm of the hand and will flow quite freely when the hand is tilted—nevertheless, the whole drop can easily be picked up between finger and thumb. When rubbed between the hands, the drop turns to an apparently dry powder, but it liquefies again on standing.

Other Properties of Matter

The list of curious properties of matter which the rheologist is called upon to investigate has by no means been exhausted. For example, there is 'fibrosity', or the property by which certain liquids can be drawn out into long stable threads. The formation of threads of silk and of artificial textiles is dependent upon fibrosity. Another property is 'dilatancy', by which a material increases in volume when it is stirred. Thus in walking over wet sands, the gloss disappears and the sand appears to dry out wherever the foot is placed; incidentally, quicksands are not dilatant and one should beware of wet glossy sands which do not 'dry out' when one is treading on them.

Yet another important rheological property is 'stickiness', which enters into the preparation and use of adhesives of all kinds and many other materials. There is 'oiliness', which is of vital importance in the study of lubrication. The rheological properties of rubber are so extraordinary that in text-books on rheology rubber usually has to have a chapter to itself. The properties of muscle (human or otherwise) are in many respects closely parallel to those of rubber.

Rheology thus covers a wide field indeed, and there are few engaged in science or industry who can afford to ignore it. It concerns physicists, chemists, biologists, engineers, medical men, manufacturers—in detail the list can be extended almost indefinitely. Hitherto, there has been no recognized society in Great Britain at which rheologists could meet to discuss the results of their work; consequently, there has been duplication, and, through ignorance of the work of others, the most efficient means are not always used in the investigation of practical problems. Without such a common meeting ground, no science or art can hope to make satisfactory progress. This is now realized by many rheologists, and steps have been taken to establish a British Rheologists' Club (see Nature, October 19, p. 518) which, it is hoped, will serve these needs in an informal way during the present emergency; and in the industrial reconstruction which will follow the War, we may expect rheology to play an important part.

OBITUARY

Sir Henry Head, F.R.S.

THE announcement of the death on October 8 of Sir Henry Head at his home near Reading at the age of seventy-nine closes the career of a great neurologist. He came of an old Quaker family, was educated at Charterhouse, and in 1880 was elected to a scholarship at Trinity College, Cambridge. In due course he graduated B.A. with a first class in physiology in the Natural Sciences Tripos. He then spent a period of two years at the German University of Prague and the University of Halle. His first paper was a contribution to *Pflügers Archiv* in 1887 on the action current of nerve, and from Hering's laboratory in Halle he published in 1889 a masterly paper on the whole question of the respiratory effects of the vagus nerve. He had himself devised a method of registration of respiration which was afterwards to become a standard method.

Head now proceeded to qualify in medicine, following study at University College Hospital, London. His M.D. thesis in 1892 was "On disturbance of sensation with especial reference to the pain of visceral disease" and was of outstanding merit. It led to the long series of investigations of disorders of sensation resulting from damage to, or disease of, the nervous system, with which his work is chiefly identified. His original study of pains referred from deep structures was followed by the elucidation of the pathology of herpes zoster (shingles), and from the pattern of the eruptions of that disease he was led to the delineation of the areas supplied by the various sensory nerve roots in man. This latter investigation, partly in collaboration with A. W. Campbell, was of great practical importance in the localization of nervous disease in medical practice, and secured him world-wide recognition. The proof of the astonishing accuracy of detail which he obtained was demonstrated by Foerster's mapping in 1933 by an entirely different method. In 1898 he was elected assistant physician to the London Hospital, and was occupied in hospital and private practice to the time of his retirement.

Head's attention was next turned to the disorders of sensation resulting from interruption of nerves to the skin. With Sherren and Rivers, in 1905 and 1908, he demonstrated the curious features of sensation at the border of an area deprived of supply by a cutaneous nerve. Here he established the existence of a zone, hitherto undescribed, where the threshold of sensation to touch, pain and temperature was profoundly altered, and discriminations of localization and intensity no longer possible. He established the existence and nature of sensations perceived through the deep nerves under skin which was completely deprived of sensation. He and Rivers described in detail and with great accuracy these changes in an experimental section of a nerve in Head's own arm.

These studies opened a whole chapter in neurology and were of great practical importance. The hypothesis by which Head accounted for these phenomena led to much discussion for many years and stimulated a great deal of investigation by others. The facts brought to light by the original investigation have been amply confirmed and little more has been added. Essentially, Head's hypothesis was that the zone of intermediate sensation represented a primitive 'protopathic' variety of sensation which he supposed to be evolutionally earlier than 'epicritic', highly discriminative qualities of sensation. His imaginative mind enlarged the conception in masterly fashion, adducing careful studies of many different aspects of sensation in man in support. The chief defect of this conception was the lack of any biological evidence of such evolution, and the failure of any subsequent confirmation that two entirely different systems of nerves existed. It is to-day more widely held that the differences are not so sharp and clear-cut as Head's methods of testing led him to believe, that more quantitative methods reveal a gradual transition, and that the qualities of the intermediate zone are the effect of the quantitative reduction of data conveyed by the nerves to the discriminative mechanism in the brain. However that may be, it is to be deplored that the discredit of Head's hypothesis should have detracted, as it certainly did, from the magnificence of his contribution to knowledge of sensation in the skin.

In 1906 Head published with Thompson studies on the conduction of sensation in the spinal cord, and again clearly defined principles which are an essential part of the practice of everyday neurological medicine. They plainly demonstrated the functions of the dorsal columns.

With Gordon Holmes in 1911 Head extended his investigations to the disorders of sensation resulting from damage to the cerebral cortex and other parts of the brain, and illuminated a whole field hitherto completely obscure. During the War of 1914–18 he gave up his private practice and lived at hospital, not only giving the benefit of all his invaluable experience, but also making new investigations, notably on the disturbances of speech resulting from localized damage to the brain, and, with Riddoch, on some of the effects of damage to the spinal cord.

Head's extensive painstaking study of disorders of speech was finally completed by the publication of two volumes on "Aphasia and Kindred Disorders of Speech" in 1926. His contribution in this field had less immediate practical importance than his earlier works, but was highly original and brought new emphasis on the complex interrelation between disorders of language and intellect. He freed the terminology of the subject from its implication of minutely localized sensory and motor components, and demonstrated the similarity in type of disturbance of both comprehension and expression from any particular damage.

In his interpretation of the late changes of spinal reflexes from spinal injury, Head invoked reversion to a hypothetical primitive state in explanation of the final disintegrated state, the 'mass reflex', again eliciting the criticism levelled against his views of 'primitive' sensation in the skin. Nevertheless, as with all his other investigations, he brought new light and abundant stimulus to the problem, and at a bound advanced the whole subject from the previous confusion of ideas and crudity of method of exploration then still prevailing in most fields of investigation of disordered physiology at the bedside.

These form Head's chief contributions, a truly noble series which placed him for all time among the small band of British neurologists—Gowers, Hughlings Jackson, Ferrier, and Sherrington, who adorn that period of remarkable advance in all medicine, 1890–1920. His other writings include a volume of verse published in 1919. He received many honours, was elected a fellow of the Royal Society in 1899, and was knighted in 1927. A man of great patience, humility and profound learning, he was fated to endure great physical discomfort and incapacity from a slowly progressive nervous disease for the last twenty years, made heavier in the last eighteen months by the loss of his gifted and devoted wife.

D. Denny-Brown.

We regret to announce the following deaths:

Mr. M. B. Buxton, president of the Institution of Structural Engineers, on October 14.

Dr. Myron Mathisson, formerly of the University of Warsaw, who during the past year has been doing mathematical research work at Cambridge, aged forty-three.

Dr. C. H. Merz, a well-known consulting electrical engineer, aged sixty-six.

Mr. E. L. Rhead, formerly lecturer in metallurgy in the College of Technology, Manchester, on October 19, aged seventy-six years.

NEWS AND VIEWS

Greece

With the open attack on Greece by Italy, a new phase of the War, centring on the eastern end of the Mediterranean, would seem to have opened. The long threatened invasion of Great Britain having been postponed—or found still-born—the Axis partners have turned to the Mediterranean, towards which the dominant member has already made an approach by taking over Rumania, in their search for a quick and resounding victory. However deeply we may regret that still another country is to be exposed to all the horror and destruction of modern war, it has become increasingly clear in the course of the events of recent months that the whole world is becoming more and more closely involved in the struggle on one side or the other, while for those people who aspire to maintain their freedom and preserve the liberty of the individual, there is no hope save in fighting on the side of those who champion the ideals of democracy.

The attack on Greece has long been foreshadowed in Italy's attitude in respect of 'incidents' on the Albanian frontier, and it is evident that steps had been taken to deal with the situation when occasion arose. Already the Greek people have experienced something of the nature of attack from the air. The proclamation of Athens as an 'open city' should serve, if respected, to preserve a city rich in archæological and classical associations. It would plumb the depths of irony if, in the struggle to preserve what is best and noblest in modern civilization, the relics of the source from which so much of it has sprung should be irretrievably destroyed.

Camouflage

The many absurdities in methods adopted for camouflage and the lack of co-ordination of research on this all-important subject formed the basis of an article in Nature of June 22, p. 949. However, some progress, though somewhat tardy, has been made, and indications of this were given by "J. S. H." in Nature of October 12, p. 482, after a visit to the headquarters of the Civil Defence Camouflage Organization. But such progress has been made by technicians in practical research; there has been little indication of improvements in co-ordination of such research, and collaboration with the military and other authorities in its application. We are therefore pleased to note that such is on the way, as shown in the fourteenth report of the Select Committee on National Expenditure (H.M. Stationery Office, price 2*d.*) The committee received a report from its sub-committee on home defence services and adopted it with an amendment as its report.

Among the recommendations made are the following: The four existing camouflage departments should be united in a single organization with its own research staff and administered by the Ministry of Home Security. Greater use should be made of the experience and knowledge of the non-departmental members of the Camouflage Committee than has been made in the past. Departments and industrial undertakings of the kind which are required to be camouflaged should, when considering plans for buildings, be under an obligation to consult the central camouflage organization proposed.

Camouflage officers required for the fighting services should be supplied by the proposed

camouflage organization. Serving officers required for camouflage duties should be seconded to it for training. The sub-committee states that the Ministry of Supply and the Admiralty have no research staff of their own and rely largely on the Ministry of Home Security's establishment. The sub-committee does not regard this as satisfactory. Recalling that two members who have great practical knowledge resigned from the Advisory Committee on Camouflage, the sub-committee is unable to acquit the camouflage departments of a certain degree of neglect of the knowledge and research placed at its disposal by members of the committee (see NATURE of June 22, p. 949). A new committee was formed afterwards.

The testimony of departmental witnesses with the longest experience of camouflage of all kinds was emphatic that specimens of camouflage of fortified posts throughout the country are absurd and cannot be regarded as camouflage at all. The responsibility for these works rests with the Home Forces and the staff of camouflage officers attached to corps and divisions. The sub-committee attributes such errors to the hitherto insufficient number of these officers. It learns, however, that the number has recently been increased. Cases have been brought to the notice of the sub-committee where private practitioners have undertaken the camouflage of industrial premises. Some of these attempts have been futile and might be dangerous. The sub-committee learns with satisfaction that most of these private firms have gone out of existence since the beginning of the War. An Admiralty witness informed the sub-committee that camouflage of ships at sea has been abandoned. In its conclusion, the sub-committee says that the defence of this country so far as camouflage is concerned is a single problem. All schemes of camouflage should be considered as part of a general picture.

Medicine in War-time

OWING to the War, many medical men are cut off from access to journals dealing with their special subjects and from all foreign periodicals. Changed conditions of war may give rise to new problems. The Medical Research Council has therefore undertaken to issue a *Bulletin of War Medicine*, containing abstracts of papers from both British and foreign sources. This *Bulletin* is to supply information, not only to specialists, but also to practising medical officers. It is intended to cover all branches of medicine that can apply to war conditions, but not those concerned more intimately with tropical diseases, or matters of purely public health interest, abstracts of which are already available in the *Bulletin of Tropical Diseases* and *Bulletin of Hygiene*. The work of searching literature and abstracting suitable papers has been entrusted to the staff of the Bureau of Hygiene and Tropical Diseases.

The first number of the new *Bulletin*, which is dated September, contains sixty-three papers. Twelve deal with surgery of special regions, nine with general diseases and eight with aviation medicine. Among the subjects dealt with are blood transfusion (eleven abstracts), shock (five abstracts), the use of sulphanilamide and similar preparations (six abstracts) and civil evacuation (five abstracts). Two abstracts only deal with food in war-time. The abstracts are thorough ; in many cases it would be unnecessary for the reader to refer to the original article for further details. It is proposed to issue the *Bulletin* every two months ; besides being distributed to medical officers of the fighting services and the emergency medical service, the *Bulletin* is being placed on sale (London: H.M. Stationery Office 2*s*. 6*d*. net.).

Mr. J. B. Priestley's "Postcripts"

IT is given to few to provide such a complete interpretation of the spirit of Great Britain as Mr. J. B. Priestley has achieved in the 'postscripts' which he has broadcast regularly during recent months. His has been the authentic voice of the country, whether in expressing the courage, resolution and good humour with which the people are meeting the challenge and dangers that confront us, or in voicing the passionate desire and determination to be found in all sections of the population that the sacrifices now being made shall issue in a new order, to be shared by men of good will everywhere, from which the grosser injustices and inequalities of the past have been eliminated. Scientific workers will share to the full the general regret at Mr. Priestley's announcement of the termination of these broadcasts, much as they will respect the reasons which have led him to that decision. All who have enjoyed these broadcasts can best show their appreciation by the wholeheartedness with which they address themselves to the tasks of reconstruction already to hand, the extent and urgency of which has been the theme of many recent articles in NATURE.

Fitness in Industry

FITNESS in industry is of primary importance to the nation, and nothing that will contribute to the good health and high morale of industrial workers should be neglected. Not the least important of its applications is the provision of the tonic effects of natural sunshine by artificial means (welfare solaria). A letter recently communicated to the Press by Mr. F. J. Pascoe, director of British Timken Ltd., describes some of the activities of his company in this direction. The Company's welfare ideas are based on years of experiment, and are not a product of present emergency conditions. The blackout, the seven-day week and night shifts deprive workers of sunlight. The Timken works produce artificial sunlight treatment. These works are large, and elaborate arrangements are justified. Suitable equipment is attainable comparatively cheaply for smaller works, but treatment must be regular and carried out under qualified supervision and in accordance with carefully prepared plans. The Timken Co. has a medical man in frequent attendance, and treatment is administered by a qualified nurse. This treatment has been found to be definitely beneficial to the workers. Short-wave

therapy apparatus is used for treating septic wounds and skin troubles met with in the industry. For a small works this apparatus is somewhat costly, but the results obtained in a relatively short time are astonishing. Treatment should be given under medical supervision.

Eyesight is of vital importance in quick and accurate production. Free eyesight tests by the visiting doctor costs the Company little and is a help to the workers. Footwear is a problem. A girl worker standing most of the day on concrete floors in thin high-heeled shoes will take very serious toll of her staying power. This is a most neglected point; workers' footwear should be stout and in good repair. Rubber soles, except in certain types of factories, should be prohibited. The Timken Co. purchases wooden shoes (sabots) which the girls buy at half their cost to the Company. Smoking is allowed. Some works cannot do this, but where it is allowable it does help. One very strict rule, rigidly enforced, is that there must be no smoking in the half hour before people knock off; the reason for this is that fires caused by cigarette ends nearly always show within that time. Music in working hours is beneficial. The Company has had long experience of this, and broadcasts records in two sessions each day to quiet shops where work is of a monotonous nature. One class of music is given in each session—waltzes or marches; mixing the different classes of music upsets rhythm. Vocal records are never broadcast; light classical music is broadcast at meal times. For A.R.P. shelters stirring choruses are used. Works canteens are sometimes dingy. There is no reason for this. Paint is cheap and pleasing and decorative ideas are even cheaper. A woman's ideas will soon brighten the canteen. Preparation and choice of food for the workers should be as carefully planned as the production in the factory.

Control of Wild Life

For various reasons in the national interest, a number of official decisions have recently been made to limit the numbers of certain species of British fauna, which in some cases will check the results of protective legislature and private efforts at conservation in the past decade. The Air Ministry has authorized the taking or the destruction of peregrine falcons or their eggs in certain areas including Ayrshire and Dumfriesshire in Scotland and a ten-mile deep area along the Kent and Sussex coasts in England, because of the risk of these falcons attacking carrier pigeons. A deer controller has been appointed to reduce the numbers of wild red deer in Lakeland and north Lancashire, where in recent years these animals have spread from the forest of Martindale and as a result of crossbreds with escaped hinds carted for hunting. A deer controller was appointed for a similar purpose with the Scottish deer forests last year. An Order prohibiting the use of any land for the artificial hatching and rearing of pheasants except under licence—which is chiefly granted to certain game farms where the birds are to be reared for food—does not include partridge and wild duck, but a recent inquiry by the Gamekeepers' Association to the Ministry of Agriculture elicited the information that an Order is contemplated prohibiting the rearing of all game for sporting purposes, and another prohibiting the use of feeding stuffs to game birds, except under licence. For the time being, this means the end of artificial encouragement of game birds and the complicated upsetting of the balance of Nature which it entails in the countryside.

Dr. Christian Fenger

Dr. Christian Fenger, the first teacher of pathology in the Middle West and an eminent Chicago surgeon, was born on November 2, 1840, at Copenhagen, where he qualified in 1876. He then went to Egypt, where he became a member of the Sanitary Council and surgeon to the Khalifa in the Cairo district. In the following year he settled in Chicago, where he was appointed consulting surgeon to the Cook County Hospital and lecturer on surgery to the College of Physicians and Surgeons. His post-mortem examinations and surgical clinics henceforward became the centre of postgraduate instruction in Chicago. During the thirty years of his professional life he contributed more than eighty articles to surgical literature, his chief work being connected with cancer of the stomach, hernia of the brain, the ball-valve action of floating gall-stones, the operative treatment of cerebral abscesses and the surgery of the ureters and bile-ducts. He died on March 7, 1902. After his death the Christian Fenger Memorial Association was founded under the auspices of the Chicago Medical Society and published his collected works in two large volumes.

All-Electric Laundry

St Gabriel's Laundry, of which an illustrated account is given in the *Electrical Review* of October 11, is the first all-electric establishment of its kind in Eire. It serves Athlone and the surrounding region and belongs to Sisters of Mercy, one of whose main activities is the domestic training of girls. Originally all the work was done by hand, water being carried from the River Shannon. In 1907, a steam engine and washing machines were installed. Recently, the laundry has been completely electrified, resulting in greater cleanliness and better working conditions. Belt-drive and shafting have been eliminated, and there has been a consequent all-round improvement. In the new wash-house there are three large washing machines supplied directly with water at 180–200° F., as required, from two 700-gallon storage electric water-heaters which feed the washing machine, rinsing troughs, soap boilers, starch emulsifier, etc. The water is heated at night so as to get the advantage of the cheap rate.

The utilization of electricity has greatly simplified the blueing and starching process. In the case of most of the work coming to the laundry, washing, blueing and starching processes are carried out without the clothes leaving the washing machine. Four methods of drying are available, three of them

electrical. The drying apparatus is divided into three groups and consists of two large hydro-extractors, a drying tumbler and a drying room. The ironing room is airy, spacious, and lighted by large windows. The electric lighting is specially designed to give perfect illumination on the work and prevent glare in the eyes of the workers. Electric hand-operated irons are installed on both sides of two long tables adequately lighted from both natural and electrical sources. There are also a collar-finishing table, two large press ironers for coats, suits, etc., and one small press ironer. A calendering machine for flat work is notable by the absence of steam. The bed of the machine is electrically heated and the roller hollow and perforated. The steam which would otherwise rise when the damp articles are heated enters the roller and is drawn off by a fan through an exhaust pipe to the outside of the building.

The Dionne Quintuplets

An editorial in the May issue of the *Statistical Bulletin* written on the occasion of the sixth birthday of the Dionne quintuplets on May 28 points out that never before has a similar event been recorded, as no other quintuplets have ever survived more than a few hours after birth. The five sisters, who were premature and tiny at birth, by living to the age of six have also surpassed the record of many normal full-born infants. Although about 94 per cent of all newborn baby girls live to the age of six, the chance of any group of five baby girls surviving to that age is appreciably smaller, namely, 75 per cent. At their present age each of the Dionne children has an even chance of living sixty-three years more. The editorial also points out that the Dionne quintuplets are fortunate not only in being born at a time when the knowledge of how to control sickness and death is being constantly extended, but even more so in having been attended by Dr. Dafoe, who used all the expedients of modern medical science on their behalf. As regards the special hazards to life and health facing the Dionne children in their coming year of life, the records of the Metropolitan Life Insurance Company show that accidents at the age of six are by far the greatest danger to both boys and girls. Next, but causing considerably less than half as many deaths, come influenza and pneumonia, closely followed by appendicitis, heart disease and tuberculosis.

A New Museum at Leicester

The opening on July 23, 1940, of the Chantry House and Newarke Houses, the former dating from 1512 and the latter a century later, as a regional museum, illustrates one successful method of preserving and using characteristic examples of local architecture (*Museums Journal*, **40**, 173; 1940). More than a quarter of a century ago these houses were threatened with destruction with a view to the erection of factories in their place; but the intervention of a few public-spirited citizens and the interest of Leicester Corporation saved the site and buildings. The new museum, to be known as the Leicester and County Museum, is planned, according to the trust deed, "for the purpose of telling the story of the City and County of Leicester in ages past and illustrating its condition for the time being and exhibiting suggestions for its reform and improvement and the promotion and extension of artistic culture and scientific knowledge". The War has delayed the fulfilment of these projects, but a beginning has been made, and the exhibits of civic ceremonial relics, early pieces of Corporation plate, wearing apparel of the eighteenth and nineteenth centuries, military uniforms, and agricultural and domestic implements, indicate the lines on which development will proceed. At present only the ground floor is being used, but the hope is expressed that soon other parts of the buildings will contain their own special collections.

Comets

Harvard College Observatory Card 531 announces the discovery of Comet Whipple, 1933*f*, by Mr. L. E. Cunningham on September 1, at Oak Ridge. Photographs made through passing clouds with the 12-inch Metcalf refractor gave the following positions:

1940 U.T.	R.A. 1950·0 (h m s)	Dec.	Mag.	Diam.
Sept. 1·1486	22 34 08·1	−0° 15·9′	15·5	10″
1·1895	22 34 06·5	−0° 16·2′	15·1	

Perihelion passage would appear to be Jan. 22·464, 1941, which is about 0·23 day earlier than was predicted. The following ephemeris uses the corrected values of T, and gives small residuals for the above positions:

1940 U.T.	R.A. (h m s)	Dec.		Δ
Nov. 3	22 24 30	6° 50·0′	2·538	1·955
19	22 36 01	−6° 59·0′	2·519	2·129
Dec. 5	22 52 18	6° 26·2′	2·504	2·316
21	23 12 18	−5° 18·8′	2·494	2·505

Card 533 announces that Mr. Cunningham has found a comet on a photographic plate taken on September 5 with the 8-inch Ross telescope at Oak Ridge. The comet appears also on eleven patrol plates taken between August 25 and September 15 at Oak Ridge or Cambridge. The estimated magnitude on August 29 was 12·9, but plates taken on September 9 show that the comet is slightly brighter and had a strong nucleus and a tail 2′ long extending southward. Orbits have been computed by Cunningham and also by Maxwell and Bendler; the elements of the latter, which differ very little from those of Cunningham, are:

$$\begin{array}{ll} T & \text{1941 January } 18{\cdot}952 \\ \omega & 197^\circ\ 29' \\ \Omega & 299\ \ 02 \\ i & 51\ \ 24 \\ q & 0{\cdot}3754 \end{array} \left.\begin{array}{l} \\ \\ \\ \\ \end{array}\right\} 1940{\cdot}0$$

Ephemeris 1940·0

		R.A. (h m)	Dec.	r	ϱ	Mag.
1940	Nov. 19	19 16	+35° 18′	1·44	1·32	8·1
,,	Dec. 21	19 18	20° 42′	0·76	0·85	3·1
1941	Jan. 22	19 59	−29° 06′	0·38	0·63	−2·1
,,	Feb. 23	20 52	46° 30′	0·93	1·40	5·4

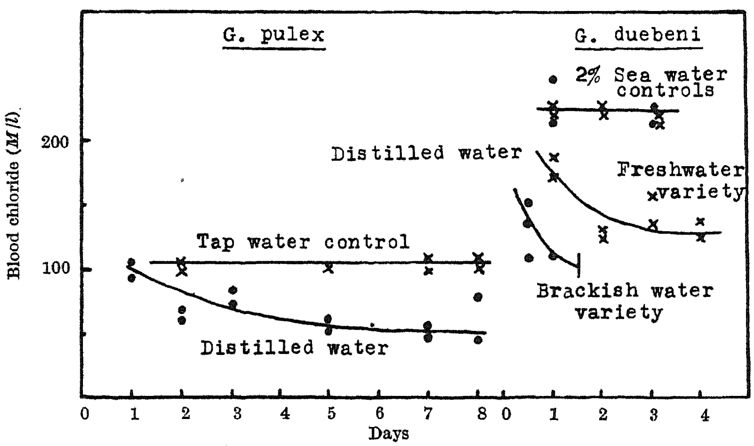
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Osmotic Regulation in Freshwater Animals

IT has recently been shown that both brackish- and fresh-water animals can actively absorb ions from the external medium against a considerable concentration gradient. Most fresh-water animals can do so from solutions as dilute as normal fresh-waters[1]. Krogh has suggested that in some cases, during periods of enforced starvation when salts are therefore not available from food, this mechanism is of survival value in maintaining the normal ionic and osmotic concentration of the blood[1]. In a recent paper[2] on the euryhaline crab *Carcinus mœnas*, Webb has gone further than this in assuming that "the active absorption of salts forms the basis of the osmoregulatory mechanism, not only in freshwater forms, but also in brackish water forms, including the euryhaline Crustacea". Without criticizing his conclusions as applied to Carcinus, we wish to point out that some experiments which we have carried out on brackish and freshwater species of Gammarus suggest that active absorption of ions from the medium is not of such universal importance as is implied in the above sentence.



The freshwater *Gammarus pulex* survived in a healthy condition when individuals were isolated and starved for at least eight days in glass-distilled water (changed twice daily). During the first two or three days there was a reduction in the blood chloride level, which thereafter remained relatively constant (see accompanying graph). Under these conditions, the possibility of absorption from the medium being excluded, *retention* of salts must be the predominant factor, for, as Webb points out, the possibility of the tissues possessing a store of chloride is extremely remote. Experiments with *Gammarus duebeni* lead to the same conclusion. This species is found in brackish water in most parts of Britain, but in some western districts it has invaded fresh-waters and it is the principal freshwater species of Ireland. Animals from brackish water rapidly lost chloride and died in distilled water, but the freshwater variety was resistant for at least four days (extent of experiment) and, after an initial loss, maintained a fairly constant blood chloride (see graph).

It is evident that an increase in the efficiency of a retention mechanism is mainly responsible for the adaptation of *G. duebeni* to fresh-water. The brackish water variety will live indefinitely, not only in 2 per cent sea water, but also in the same concentration of pure sodium chloride. Thus the power to retain ions other than Na^+ and Cl^- is well developed. Finally, we would quote experiments on the freshwater crustacean *Asellus aquaticus* (unpublished), which was unaffected by treatment for eight days with distilled water, and on the mosquito larva *Aëdes detritus*, which can live for long periods in distilled water, pure sodium chloride and glycerol solutions[3].

We have also found that *Gammarus pulex* and *G. duebeni* can actively absorb chloride from the external medium, but our experiments with distilled water show that this is not an essential part of the osmoregulatory mechanism. There is, in fact, no direct evidence that any freshwater animal is dependent upon salt absorption from the medium for the maintenance of an adequate concentration and composition of its blood.

We hope to publish these experiments in detail when we have the opportunity to extend and complete them.

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Golgi Apparatus as an Indicator of Secretory Activity in Pancreatic Islet Cells

Anselmino, Herold and Hoffmann[1,2] claimed in 1933 to have demonstrated a "pancreotropic" activity of pituitary extracts. Their claims rested on experiments in which a crude extract of the pituitary body was injected into young rats; in a few days an increase in the number of the islets of Langerhans was observed. The increase in islet tissue was ascribed to the action of a substance normally present in the pituitary gland. These observations were confirmed by several authors[3,4,5], and denied by others[6,7,8]. The majority of the investigators based their conclusions on anatomical and morphological variations of the pancreas islets, a somewhat subjective method of appreciating quantitative changes. The individual variations in the disposition and volume of the islets in the animals usually employed are unexpectedly large, and opinions based on inspection of microscopic sections, even serial sections, are unreliable. Richardson and Young[9] have applied a quantitative method of estimating the ratio of islet-acinar tissue for Wistar rats, and have found that the mean value of this ratio in animals treated with a saline extract of fresh pituitary gland is double that of normal rats, a difference which is statistically significant. Extracts prepared by the methods used by Anselmino had no such effect.

Fig. 1.

Pituitary hyperplasia accompanied by enlargement of the islets of Langerhans can be brought about by the prolonged action of œstrogenic substances[10]. Material suitable for the study of fine changes in the islet cells, changes which may be an index of endocrine activity, can thus be easily obtained. I am indebted to Dr. Gye for providing tissues of many mice of diverse age, of several strains and of both sexes, which had been treated with œstrogenic substances during variable periods of time, but always at least several months. Many of the animals examined presented pituitary enlargement with hæmorrhages; in others the hyperplasia was not so pronounced, but cytological modifications were always the same and suggested the existence of states of hyperfunction. Some of the animals bore malignant tumours, mainly mammary carcinoma.

The cytological alteration found in these animals to which I wish to direct attention is the presence, in *every* cell of *all* the islets of Langerhans that have been examined, of a hypertrophic Golgi apparatus of a size never observed in the normal mouse. The normal Golgi apparatus consists of a number of threads in the vicinity of the nucleus, sometimes forming a tightly threaded network; in mice treated with œstrin it appears as dense thick regular threads in the form of a loose net with clearly visible spaces, spread all through the cytoplasm of the cell (Fig. 1). Whilst the normal structure resists our methods of impregnation, the altered structure is easily rendered visible. We employ the Cajal formol-uranium method and with this technique failure to demonstrate hypertrophy of the Golgi apparatus in every cell of an islet is exceptional.

Fig. 2.

The cells of islets are generally notably increased in size, and sometimes cells with two or more nuclei are found. In such cells the Golgi apparatus reaches its maximum size, enveloping the nuclei and presenting excellent conditions for detailed study (Fig. 2).

It is interesting to note that Ludford and Cramer[11] found that in pregnancy the Golgi apparatus of the cells of the islets is frequently enlarged and conspicuous.

The presence of giant islets with or without acinar residues and the apparent formation of new minute islets cannot be accepted as proof of absolute increase of the endocrine portion of the pancreas; but we have found with relative frequency a type of architectural alteration which seems to be the result of proliferation of the insular cells. Instead of a structure of chains of cubic or prismatic cells, more or less regularly disposed around the capillaries, there are islets, especially the larger ones, in which the cells

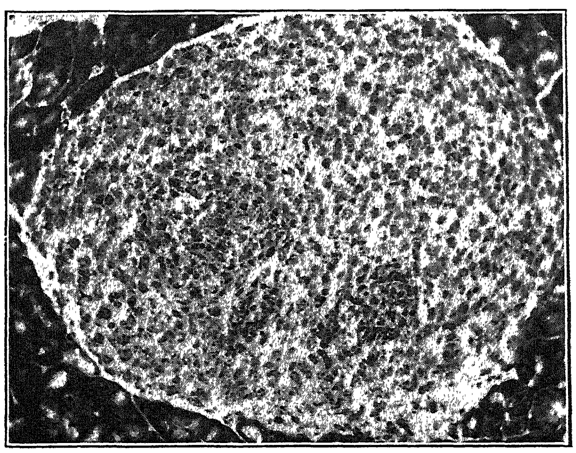

Fig. 3.

appear compressed and elongated by pressure of neighbouring cells, with nuclei ovoid in shape, homogeneous and intensely stainable. The disposition *en tourbillon* of the cells can be clearly appreciated when the section corresponds to a zone in which only a part of an islet seems to be affected, the nodules being especially shown up by their nuclear density from the tissue that is normal (Fig. 3).

Griffiths and Young[12] have demonstrated an increase in the insulin content of the pancreas of rats treated with œstrogenic substances. We think that the modifications briefly described above represent the histological basis of functional hyperactivity dependent upon excessive pituitary stimulation.

E. Vazquez-Lopez.

Imperial Cancer Research Fund,
Burtonhole Lane,
The Ridgeway,
Mill Hill,
London, N.W.7.
Oct. 4.

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Biological Effects of High-frequency and Magnetic Fields

Since diathermy first became a generally recognized method of treatment and especially after short-wave therapy was universally accepted, the controversy as to whether the heat effects alone account for the biological effects has not ceased. No other physical effect but heat has, however, up to the present been proved to exist while high-frequency currents are applied.

In the course of more than a year's work with an 'Inductotherm' short-wave diathermy apparatus it has become, by clinical observation, obvious to me that the magnetic field produced as well as the electric field was of some effect. An investigation of the effect of magnetic fields of different kind showed that small differences of potential and actual electric currents were produced inside biological objects very much after the principle of a dynamo, the biological object acting as the rotor.

The application of a concentrated magnetic field between the narrowly tapered poles of a D.C. magnet produces in a glass tube of 0·5 cm. diameter electrical potential differences if a salt solution or blood is pumped through it. With a D.C. magnet of 5,000 gauss and a velocity of flow of a salt solution of 60 cm. per second, potential differences of about 2 millivolt could be produced. This is well within the range of biological currents of the heart or the brain.

In the case of a D.C. magnet the production of electric currents within the tissues depends on the blood flow with the pulse. With A.C. magnets the changing of the direction of the field adds to the production of these currents. With high-frequency currents the magnetic field alternates so quickly, that the movement of a stream of liquid is no longer needed, and electric currents are produced also in capillary and lymphatic areas, even in non-vascularized tissues.

While with D.C. magnets electric currents of a certain direction can be produced, electric currents produced by A.C. and high-frequency magnetic fields cannot be directed, but originate more or less in the form of eddy currents. But the possibility of localizing diathermy and ultradiathermy makes it possible to concentrate the production of these electric currents in circumscribed areas or organs.

It seems certain that these magnetically produced electric currents play a part in the effects of diathermy treatments. They probably account for the immediate relief of pain in some cases, long before any measurable rise of temperature in the tissue occurs. The production of electric currents inside the tissue differs from the ordinary external application of electricity exactly in the same way as the production of heat in the tissue by diathermy differs from externally applied heat.

Biological and clinical investigations along these lines have been started.

K. F. Nagelschmidt.

Edgecoombe,
The Avenue,
Bury New Road,
Manchester.
Sept. 30.

The Existing Coelacanth Fish, Latimeria

In my review of Prof. J. L. B. Smith's account of the existing Coelacanth fish, Latimeria (Nature, July 13, 1940, p. 53), I remarked that the fins appeared to agree with those of the fossil Coelacanths in all respects except the considerable extension backwards of the membrane of the anterior dorsal fin.

According to the annual report of the South African Museum for 1939, the dried fish has been prepared anew with great skill by the Museum's taxidermist, Mr. James Drury, and it is now evident that such an extension of the anterior dorsal was deceptive. All the fins of Latimeria, therefore, are of the normal Coelacanth type. As shown by the photograph published in the report, Mr. Drury has made an excellent restored cast of the fish, of which it will be possible to distribute copies. There seems to be only one small feature open to criticism—the bifurcation of the rays in the hinder portion of the pectoral fin. All the fin rays hitherto observed in Coelacanths are simple rods, and those preserved in the specimen of Latimeria are likewise without any distal sub-division.

A. Smith Woodward.

Hill Place,
Haywards Heath,
Sussex.

RESEARCH ITEMS

Pueblo Indian Irrigation Systems

An attempt to reconstruct the methods of irrigation developed by the Pueblo Indians, the earliest agriculturists among the indigenous inhabitants of the United States, in cultivating the arid lands of the south-west in the period preceding the Spanish conquest, has been made by Guy E. Stewart (*Scientific Monthly*, **51** ; 1940) on the evidence mainly of an examination of ancient sites of cultivation, more especially the famous Mesa Verde, where early abandonment places Old World influence out of the question. Here the Far View group of ruins is near the upper end of an unusually complete unit of flood water irrigation which begins from a circular reservoir for flood water now known as Mummy Lake. This supplied cornfields and check dam areas along the Mesa top by a primitive ditch. Deposits of silt 10 ft. deep in the Lake indicate use over a long period. Evidence along the ditch indicated where water might have been turned off to the cornfields and where additional water might have been picked up. The cross-section of the ditch is broad and flat, and the ditch has a remarkably uniform grade. Two areas of garden check dams were located adjacent to the flood water ditch. The check dam type of village gardens is a characteristic of agriculture at Mesa Verde. They vary widely in size, ranging from 6 ft. × 9 ft. to 35–40 ft. wide with a cultivable breadth of 10–15 ft. All have a definite type of construction with the corner of the dam well toed in to the bank to give stability. Most of these were built on rock ledges. The entire length of the flood water supply ditch from Mummy Lake to the lower check dam area measures approximately four miles. The purpose of the system was evidently water conservation. Evidence of similar or analogous systems has been examined on the Rio Grande and Gila Rivers.

Infra-Red Transmission of the Human Body

C. Hawley Cartwright, John Daniel and Alex Petrauskas, of the Massachusetts Institute of Technology, described experimental research on this subject in a paper at the annual meeting of the U.S. National Academy of Sciences during April 22–23. The percentage reflection and transmission of a human cheek was measured as a function of wave-length in the visible and infra-red spectra. Absolute values were obtained to 12,000 A. by using a special photocell and an integrating sphere, for collecting all the light. The reflection of the cheek reaches a maximum of about 50 per cent in the visible red and gradually decreases for longer wave-lengths. The cheek (10 mm. thick) is opaque below 6050 A. and increases its transmission linearly to about 2 per cent of that entering the skin at 7000 A. Between 7000 A. and the water absorption band at 10,000 A., the transmission is rather uniform. Beyond 10,000 A., the transmission rises, reaches a maximum value of about 3 per cent at 11,000 A. and decreases to zero beyond 13,500 A., due to the water absorption. Using as a control a bearable discomfort on the outside of the cheek, measurements of the temperature rise inside the mouth were made using various sources of radiation. The best of these was a tungsten lamp with a water filter. An increase in temperature of 3° F. was obtained inside the cheek without external discomfort.

Indian Copepods

Dr. F. Kiefer, in a handsome monograph, has described the copepods collected by the Yale North India Expedition, which made a speciality of the study of the lakes, tanks, ponds and pools in the area investigated (Freilebende Ruderfusskrebse (Crustacea, Copepoda) aus Nordwest und Südindien (Pandschab, Kaschmir, Ladak, Nilgirigebirge), by Friedrich Kiefer, Karlsruhe (Baden). Scientific Results of the Yale North India Expedition. Biological Report No. 19. *Mem. Indian Mus.*, **13**, Part 2 ; 1939). The bulk of the work is confined to systematics and descriptions of the species with careful drawings, but there is included a detailed account of their ecology and geography and a list of the free-swimming freshwater copepods of India. A key is given of the males and females of the species of the genus Neodiaptomus Kiefer (six in all). 27 species of copepods were collected, 10 of which are new. Most of them are from altitudes ranging from 1,000 to 5,000 metres. Eucyclops (a separate genus according to Kiefer, but regarded as a sub-genus by Gurney and others) has a world-wide distribution. In the present work three species are recorded. A recent contribution to the study of these forms is by K. Lindberg (Cyclopides (Crustacés, Copépodes) de l'Inde. III. Une Revision des représentante indiens du sous-genre *Eucyclops* s.str. (Groups *serrulatus*.) *Rec. Indian Mus.*, **41**, Part 4 ; 1939).

Peculiar Water Relations of a Diatom

In a recent publication D. Bhatia (*Proc. Roy. Soc. Edin.*, 60, 245 ; 1940) has continued the study initiated by Gross of the remarkable water relationships of the diatom *Ditylum Brightwelli* (West). This diatom plasmolyses rapidly in isotonic and hypotonic sodium chloride and sugar solutions and also, more slowly, in sea water in the dark. Weak concentrations of urethrane produce effects similar to those produced in the absence of light, namely, delayed plasmolysis and immediate recovery on return to normal conditions. Inhibition of oxidative processes by treatment either with cyanides or sulphides causes immediate plasmolysis, and the subsequent recovery on return to normal is delayed if the oxygen inhibition is prolonged beyond 8–10 hours. Similar effects are obtained in 'reduced' sea water. Absence of light is without effect in this relation of oxygen deficiency to plasmolysis. The effects of alcohols do not resemble those of light or oxygen deficiency, for plasmolysis is incomplete or else the effects are destructive. Their effectiveness follows the series methyl < ethyl < butyl < amyl < octyl. Rapidly formed 'artificial' resisting spores (plasmolysed cells) recover partially in the absence of light before beginning to shrink again, as also do spores under anaerobic conditions. 'Exhausted' resting spores (plasmolysed in the dark) never recover. Resting spores formed under oxygen deficiency recover partly if oxidation is restored but assimilation prevented. It is suggested that under normal conditions turgor is maintained by secretion

of cell sap at the expense of energy released by respiration. An energy-precursor, produced during assimilation, is also necessary. With the inhibition of assimilation (darkness or urethrane) this energy-precursor is reduced, and after using up its store in 15–20 hours the cell begins to plasmolyse. Inhibition of oxidation, on the other hand, causes immediate plasmolysis owing to the withdrawal of the necessary energy. Recovery consists of two stages: an initial anaerobic process dependent on the presence of energy-precursor and connected with change in state rather than volume, and the subsequent complete recovery which depends on the presence of oxidative processes.

Unequal Breaks in Sister Chromatids

M. Demerec and E. Sutton (*Proc. Nat. Acad. Sci.*, **26**, 532–536; 1940) show that, as a result of X-rays, one of the two sister chromatids may be broken at one point, while both chromatids are broken at a second point in the same chromosome. Females of a strain of *Drosophila melanogaster* which were heterozygous for *dm* had diminutive bristles, and some showed mosaic spots covered with wild type wing bristles. Cytological observation confirmed the supposition that a chromosome rearrangement involving *dm* and heterochromatin had taken place. Further investigation showed that one chromatid of the X-chromosome has a deficiency involving changes of several known gene loci, while a slightly shorter segment has been translocated from the sister chromatid to the fourth chromosome. It is believed that one electron hit produced all the changes noticed.

Aleutian Islands Earthquake

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of August 22 at 3h. 27m. 18s. G.M.T. from reports received from twenty seismographic observatories. The epicentre appears to have been at lat. 51·9° N., long. 164·9° W., which is in the Pacific Ocean to the south of Unimak Island in the Aleutian Islands group. This is a continuation of the seismic activity previously reported in the Aleutian Islands, though it is somewhat to the east of other recent earthquakes in this neighbourhood. An earthquake was recorded at Kew Observatory on August 22 at 3h. 39m. 3s. G.M.T., attaining a ground amplitude of 84 μ at Kew, and provisionally estimated at Kew to have taken place 8640 km. away.

Reaction between Chlorine and Nitric Oxide

The combination of nitric oxide with chlorine: $2NO + Cl_2 = 2NOCl$, has always been considered a homogeneous termolecular reaction, but E. M. Stoddart (*J. Chem. Soc.*, 823; 1940) finds that it can be considerably influenced by surface conditions and hence concludes that it is really heterogeneous in character. The nitrosyl chloride, by adsorption on the walls of the vessel, can inhibit the reaction so that it ceases altogether. The kinetic experiments can be interpreted by assuming that the nitric oxide associates to $(NO)_2$ on the surface, and the complex may or may not undergo homogeneous reaction with chlorine according to whether the complex molecule has or has not been stabilized by the surface of the reaction vessel, the latter being assumed to be composed of active and inactive portions. The unusual assumption that the surface and gas phase are not in equilibrium, is also necessary to explain the results.

Scale Formation in Electric Water-Heaters

In an article on electric water-heaters by J. F. E. Edgell, consumer's engineer to the City of Gloucester, in the *Electrical Times* of October 3, it is stated that the storage capacity of a 1½ gallon cylinder can be reduced by scale to a ¾ gallon capacity in a period of service of only one year. Illustrations are given of severe practical examples of scaling. Last July, J. I. Bernard read a paper to the Institution of Electrical Engineers on this subject, in the discussion of which Mr. Edgell took part; the paper and discussion are published in the October issue of the *Journal* of the Institution. Mr. Bernard referred to the usual classification of water as hard and soft, the former being distinguished by a small content of lime which is deposited in the form of 'scale' on heating. Soft water, on the other hand, frequently contains traces of carbonic acid, and when heat is applied it is liable to corrode base metals, such as iron and lead. Hence the prevalent use of copper for hot-water storage vessels in soft-water districts, in contrast to the use of iron tanks where hard water is encountered. Analyses of scale deposits show a variety of salts, principally calcium carbonate and also calcium sulphate, magnesium hydrate, etc., most of which are not precipitated until a temperature of 180° F. is reached. Mr. Edgell stated that while this is most probably correct for most salts, a lot of precipitation occurs at a much lower temperature. He submitted also that the temperature at which liberation of the carbon dioxide gas occurs is governed to a large extent by the turbulence of the liquid. The liberation of carbon dioxide is, of course, the root cause of scale formation.

Theory of Nuclear Resonances

G. Breit, of the University of Wisconsin, discussed this subject in a paper at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. He pointed out that pronounced resonances are observed in a number of nuclear reactions, and it is customary to interpret these as due to the formation of temporarily stable states of the compound nucleus. While this qualitative picture is applicable in many cases, its quantitative validity is doubtful. Some limitations of the 'dispersion' treatment which become apparent when the wave equation is treated accurately are as follows: (*a*) Coupling through the field changes the position of the levels in addition to the Dirac frequency shift. (*b*) The same energy level should not show peaks at the same energy in different reactions. Shifts of the order of the level width are expected. Sufficient conditions for the absence of shifts are known. (*c*) The combined effect of several levels shows itself in interference in both the numerator and denominator of a fraction. (*d*) Neither the regular nor the irregular (F, G) solutions of the radial wave equation are universally applicable to the computation of mean lives of compound states. Green's function for two and more dimensional separable problems is used for an estimate of competitive effects of nuclear excitation. Additional justification is given to the form of dispersion theory worked out by Wigner and Breit.

EVACUATION OF THE VERY YOUNG

THE further report on evacuation (Evacuation: the Under Fives. August 1940) by the Evacuation Committee of the Association of Architects, Surveyors and Technical Assistants deserves wider attention than it appears to have yet received, particularly in view of the determined policy of evacuation urged by Lord Horder and the statement of Mr. Malcolm MacDonald, Minister of Health, to the House of Commons on October 17. Mothers and children, he said, are leaving London at the rate of several thousands a day. Already about 489,000 school children or some 56 per cent of the school children in the London evacuation areas had left, and 300,000 out of 500,000 in the L.C.C. area had gone to reception areas.

This movement, which gains part of its present importance by the indirect consequence of reducing the demand for deep shelter and the risk of overcrowding, removes to safer areas some of those most liable to dangers to health which attend nights in deep shelters, apart from the special risks of overcrowding. From every point of view their removal out of London is to the good, but as was shown in the report to the Fabian Society edited by Richard Padley and Margaret Cole entitled "Evacuation Survey" (see NATURE, October 5, p. 439) the evacuation of very young children presents special difficulties and problems. The present report makes a very definite contribution to an acute problem, and adoption of its recommendations should prevent a number of the mistakes made in the earlier evacuation being repeated as well as offer safeguards for the health of those going to the reception areas.

The report points out that in August some 750,000 babies, belonging to about 500,000 mothers, were in dangerous areas, as well as more than a million children between two and five. Any evacuation scheme to the relatively safe areas must be based on a thorough re-zoning of the British Isles by competent military and civil authorities taking into account both types of dangerous area. The failure of the first scheme is attributed to lack of consideration for the psychology of family life, coupled with a lax definition of safety areas, the absence of satisfactory arrangements to accommodate mothers with young children, and the placing of the responsibility for carrying out the scheme on local authorities who were not sufficiently interested or qualified. The principle of evacuation was not at fault. Failure of the general scheme as a whole was due to insufficient understanding of the problems which are involved and refusal to deal with the many deficiencies that appeared by financing a workable scheme.

The scheme put forward in this report is founded on the belief that no baby under two years old should be sent away from its mother unless in special circumstances a close and suitable friend can be found to act continuously as a foster-mother. Most two- to five-year olds can be successfully separated from their parents if a mother substitute looks after them in small groups. Groups of four or five children may be joined together in school units of not more than twenty children.

An evacuation allowance should be available for mothers of babies under two or of several children under five, so that they have a free choice of whether to evacuate or not. Evacuated mothers must have independence in managing their own families and must be fully used in caring for other unaccompanied children. Visits by husbands must be possible, and for this purpose reduced fares and overnight accommodation must be provided. Temporary day nurseries must be set up for all children under five in the dangerous areas as part of the organization for evacuation and to establish confidence in it. Welfare centres and young people's hostels will also be required for members of the family who are left behind. Local authorities in the dangerous areas should be empowered to act equally with those of the reception areas in initiating evacuation arrangements.

The second essential is proper accommodation in the reception areas. The only way of evacuating mothers and young children immediately is into group billets, and accordingly it is proposed that the large country houses in safe areas should be immediately requisitioned for the reception of three quarters of a million mothers and children under five. A building programme is also essential. This should be carried out in stages; first, making all suitable existing buildings usable; second, providing sleeping and feeding accommodation; and third, the provision of day crèches, playrooms and staff accommodation. The report suggests that less alteration than is often supposed will be required for the large houses. The extra sleeping and feeding accommodation to be constructed includes family cottages and hostels for mothers and babies, and sleeping and feeding sections of residential nursery schools for children of two to five years.

This building programme avoids, to a great extent, using materials which are imported or urgently wanted for war purposes, and skilled site labour. An adequate quota of materials and labour must, however, be made available by the Government. The whole cost of the scheme is estimated at £100–£140 millions, and this expenditure would have important results in morale and organization during the War as well as provide permanent assets to the community.

The second part of the report gives details of the recommended planning standards for the new buildings proposed with detailed suggestions for economy of available materials in construction and sketches of typical designs for the alteration of existing country houses and the erection of family cottages for two mothers and children, a hostel for twelve mothers and children, a day crèche for twenty children under two years old and a residential nursery school for forty children in two separate groups with a matron, two assistant teachers, eight foster mothers and a cook.

The report appears to represent exactly that type of positive criticism for which Mr. Bevin recently appealed and indicates the opportunity which still remains for retrieving past mistakes and profiting by them to build better.

TRANSFORMER INSULATING OILS

A USEFUL paper on transformer insulating oils was read by B. Calvert before the Sheffield Section of the Graduates and Students of the Institution of Electrical Engineers last year and is now printed in their *Quarterly Journal*.

Mr. Calvert points out that Faraday appears to have been the first to examine oily liquids for their insulating properties. The first commercial use made of his discoveries was in connexion with telegraph cables, for which rosin oil was employed. With alternating current transformers, the high temperatures used in practice made rosin oils unsuitable because of the formation of sludge and rapid evaporation of the oil. Thus modern transformers are usually immersed in mineral oil, which is freer from these disadvantages.

Quite recently a synthetic oil patented under the name of 'Pyranol' has been found excellent for insulating purposes and is extensively used in America. The crude oils from which insulating oils are derived can be divided into three types: first, those having a composition of more than 66 per cent of paraffins, that is, saturated open-chain fatty hydrocarbons, such as Pennsylvanian oils; secondly, those consisting of more than 66 per cent of naphthenes, such as Russian oils; and thirdly, those having not more than two-thirds of either paraffins or naphthenes in their composition, such as Rumanian and Texas oils.

The insulating oils obtained from these crude oils are separated by fractional distillation and then purified with sulphuric acid; the tarry deposit resulting from this treatment is removed. The oil is then washed with caustic potash and water to remove any trace of acid. In order to remove the last impurities, such as fibres and dust, from the oil it is finally centrifuged and filtered before dispatch.

The cooling of a transformer depends principally upon the viscosity of the oil used, on which depends the convection currents; the transference of heat being more rapid with low viscosity. Unfortunately, as the viscosity decreases, flashpoint decreases and volatility increases. Thus a compromise has to be made since loss by evaporation is objectionable and fire risk should be as small as possible. Besides these properties, the oil must remain fluid at the lowest temperatures likely to be met with when the transformer is off load. The temperatures at which oils cease to be fluid vary considerably, some congealing at about the freezing point of water, others requiring a temperature lower than −40° C. Two further important attributes of a transformer oil are maximum resistance to the formation of sludge and acid when in service. In Great Britain the principal requirements have been defined and standardized by the British Standards Institution in specification No. 148/1933 entitled "Insulating Oils for Electrical Purposes other than Cables". It also describes the methods of test and the apparatus required.

The oil deteriorates under working conditions, and it is the manner and results of this deterioration that are of moment to the engineer using the transformers. From this point of view the most important characteristic is the variation of the electric strength. The presence of water and particles of solid matter in the oils have the effect of lowering the breakdown value. For example, a mixture of 4 c.c. of water with 3·74 mgm. of fibre in 10,000 c.c. of oil is sufficient to lower the electric strength of a clear dry oil from 100 kilovolts to 37 kilovolts, although both water and fibre are in a pure state. It should be noted that oil absorbs moisture from the atmosphere and therefore, if possible, the filling of transformers or other apparatus with oil should not be done on wet days.

Pyranol is widely used in the United States, especially for indoor and traction work, because of its non-explosive and non-inflammable characteristics. Owing to the removal of the restrictions as to the use of fire-proof vaults, etc., the cost of the Pyranol-filled transformer is generally cheaper than the oil-filled installation. Owing to the high cost of pyranol, it is not thought that it will be widely used in Great Britain, at least for the present. Mr. Calvert thinks that there are cases where its use may be justified. In boiler houses air-cooled transformers have been installed owing to fire risks. In many cases pyranol transformers would be a better substitute, and on economic grounds alone would probably be justified.

ELECTRIC STRENGTH OF SOME SOLID DIELECTRICS

IN connexion with the theory of the breakdown of solid dielectrics, the British Electrical and Allied Industries Research Association has made a helpful technical report* discussing important theories which have recently been advanced, and describing methods by which the 'intrinsic' electric strength of solid dielectrics may be defined and evaluated. It is shown that the magnitudes of, and the effect of temperature and thickness upon, the electric strength of certain crystals agrees with Fröhlich's theory of electronic breakdown. The effect of disordered structure and microstructure also agrees with it in similar instances. On the other hand, departures from theory occur with complex organic dielectrics, and also with crystals when certain limits, for example, of the temperature of the material, are exceeded. Some observations are also made on the effect of temperature and electric stress upon the conductivity of the material.

The object of the present report is to amplify a previous note by A. E. W. Austen and W. Hackett (NATURE, April 15, 1939; p. 637). Experimental values of the electric strength of certain solid dielectrics are compared with the values predicted theoretically from the known structure of the materials. The electrical breakdown is often influenced by the thermal and special electrical conditions

* Tech. Report, Ref. L/T 114: The Electric Strength of Solid Dielectrics in relation to the Theory of Electronic Breakdown. Pp. 18+9 plates. (London: British Electrical and Allied Industries Research Association.) 3s.

under which the test is made; for example, the breakdown due to discharges in a surrounding medium or due to thermal instability. For the present purpose, the electric strength measured must be independent of such conditions. It appears that a type of breakdown which is a property only of the physical nature of the dielectric and its temperature exists, and may be defined. It has been called intrinsic breakdown, and the corresponding field strength is termed the intrinsic electric strength.

Intrinsic breakdown should possess the following properties: (*a*) it should be independent of thickness over a fairly wide range; (*b*) it should be independent of the nature or duration of the electric stress, provided no appreciable change of temperature occurs as a result of the application of the electric stress, and provided the duration is sufficiently long; (*c*) the actual discharge should occur wholly within the dielectric and in the region where the field is most intense. In the experiments it was found convenient to satisfy certain further conditions.

Attempts have been made to identify intrinsic breakdown with various mechanisms. Fröhlich has examined mathematically the equilibrium of an electron in a solid. His theory shows that beyond a certain critical field-strength an electron may gain energy from the field, and will eventually ionize the lattice. The following deductions can be made from Fröhlich's theory: (*a*) breakdown should increase with temperature for materials having a low Debye temperature, and be practically independent of temperature for substances with a high Debye temperature; (*b*) the electric strength should be independent of thickness until the thickness approaches the order of the electronic mean free path, when the electric strength should increase with decrease of thickness.

Many interesting experimental results on mica and on glass, both plain and coloured, are given. The report concludes that it has been shown that the electric strength of certain solid dielectrics may be defined in such a way that it is independent of the immersion medium, if any, of the shape of the specimen, of the nature of the electrodes, of the nature of the electric stress provided the maximum value persists for a period of a few micro-seconds, and of the thickness, within certain limits. Excellent diagrams are given showing comparisons between experimental and calculated values, the agreement of the variation of conductance with temperature, and the electric strength of clear ruby muscovite-mica.

Based on this report, a paper by A. E. W. Austen and S. Whitehead on the same subject has been communicated to the Royal Society, and is published in the *Proceedings* (A) of August 28, 1940. It describes some recent measurements of the intrinsic electric strength of certain solid dielectrics. This property of homogeneous solid dielectrics is defined, and methods of measurement suitable for a wide range of materials and conditions are described. A comparison of experimental results with Fröhlich's theory yields the following conclusions: (*a*) the electric strengths of mica, quartz, potassium bromide, and other alkali halides agree with the theory; (*b*) the effect of temperature on the electric strengths of mica and potassium bromide agree qualitatively with the theory, while for mica the agreement is also satisfactory quantitatively; (*c*) the electric strength of mica increases when the thickness is reduced to the order of a few mean free paths, and the agreement is quantitative to the accuracy with which calculation is possible; (*d*) fused quartz has a relatively higher electric strength than crystalline quartz, corresponding to the prediction of the theory that disorder increases the electric strength.

YELLOW FEVER AND ITS CONTROL*

IN research on yellow fever to-day, the tiny chick embryo, both as minced tissue culture and as the whole embryo in the shell, is one of the most important of the experimental animals used; but man himself was the only useful experimental animal in the study of this disease until as recently as 1927. Research was thus impeded until that time by the reluctance to expose human volunteers to so dangerous an experimental infection.

The extensive history of attempts to learn how the disease was transmitted reveals, nevertheless, that numerous medical men, without thought to their own comfort or safety, performed the most unpleasant experiments upon themselves. A medical student of the University of Pennsylvania during 1802–1803 placed black vomit and blood serum from yellow fever patients in wounds made in his arms and legs and injected black vomit into animals. Other early experimenters exposed their skins to the soiled clothing, bedding, sweat, black vomit, tissues or blood of yellow fever patients.

In none of these experiments did the yellow fever 'take', and the evidence therefore seemed strong that the disease was not contagious. However, there was so much interest in the disease that a total of 556 articles on it are referred to by a writer of 1827, reviewing the literature since 1797.

Although generally accepted proof that a mosquito was the carrier of the disease was not established until the work of Dr. Walter Reed and his associates of the U.S. Army Yellow Fever Commission in 1900 and 1901, Dr. Carlos J. Finlay, of Havana, declared as early as 1881 that he was convinced a mosquito was responsible; and he pointed to the right species, namely, *Aedes ægypti*. Finlay used 102 human volunteers, who permitted themselves to be bitten by mosquitoes which had sucked the blood of yellow fever patients. That the few illnesses observed among his volunteers could not be accepted as yellow fever is due, Dr. Sawyer suggests, to the fact that Finlay did not let the virus incubate long enough in the mosquitoes before they bit the volunteers.

After Reed's brilliant work showed the way to successful control of yellow fever by eliminating the mosquito, no important new discoveries about the disease were made for another quarter century. This was partly because of the deaths of several human volunteers and the reluctance to use more.

Interest in the possibility of immunization was aroused when, in 1927, Drs. A. Stokes, J. H. Bauer and N. P. Hudson, while making investigations in West Africa, discovered that Asiatic monkeys,

* From a paper by Dr. Wilbur A. Sawyer read on September 17 at the Bicentennial Conference of the University of Pennsylvania.

including the common rhesus monkey, were susceptible to yellow fever. Monkeys were immediately used in the research laboratories to study the disease, but during the first few years of this work many scientific workers became infected and several died. Since the development by Drs. Sawyer, W. Lloyd and W. A. Kitchen in 1931 of a vaccine with which all members of the Rockefeller Foundation yellow fever staff are inoculated, there have been no accidental infections among this group. The vaccine consisted of virus cultivated in mice and when injected was accompanied by a protective quantity of blood serum from people who were immune to the disease.

A curious characteristic of the yellow fever virus which has proved of value in developing vaccines is its manifestation of two types of virulence, namely, 'viscerotropism', meaning that it attacks such viscera as the liver, kidneys and heart, and 'neurotropism', meaning that it damages the nervous system. As the virus occurs in Nature it is capable of inflicting both kinds of damage and is therefore said to be 'pantropic'. But man ordinarily suffers only the viscerotropic attack—in his liver, kidneys and heart. The mouse, on the other hand, is susceptible only to the attack on the nerves, and after long passage through a series of mice the yellow fever virus becomes almost purely neurotropic, that is, capable of attacking only nerve tissue and having little power to damage viscera. It was such a modified virus strain that was thought safest to use on man as a vaccine, since man was thought to be relatively resistant to the neurotropic attack. Nevertheless, immune serum was given with the vaccine to prevent the possible occurrence of a yellow fever encephalitis (brain inflammation).

The next step was so to modify the virus strains that they lost their affinity for the nervous tissue also, and this was attempted by growing the virus in culture media consisting of chick embryos from which the brain and spinal cord had been removed, so that the virus had no nerve tissue on which to grow. The strain thus produced actually has a low virulence for nerve tissue as well as for viscera, and it seems to have undergone a permanent 'evolution' in this direction, for it can now be grown on chick embryos containing the nerve and spinal cord without increasing its virulence for nerves. It is not known, however, whether the fortunate radical change in the virus was due to the absence of brain and cord tissues from the tissue cultures or to an unknown factor. At any rate, this vaccine, produced by workers in the Rockefeller Foundation, and known as 17 *D*, has been used to vaccinate more than a million people in Brazil with results pronounced 'on the whole very satisfactory'.

Another new angle of the yellow fever control campaign is the discovery that not all yellow fever is carried, as had been thought for many years, by the *Aedes œgypti* mosquito, which usually frequents the environs of towns and cities. Yellow fever has also been found in the wild areas of central Africa and South America. It is known as jungle yellow fever, and is probably carried by several species of mosquitoes and possibly harboured also by monkeys and other animals. If jungle fever reaches cities infested with the *Aedes œgypti* it can get into these mosquitoes and start an epidemic of the familiar urban yellow fever. Therefore mosquito control is still an effective weapon. In Brazil, this control includes putting fish in the cistern and water jars to consume the mosquito larvæ.

FORTHCOMING EVENTS

Tuesday, November 5

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, S.W.1), at 1.30 p.m.—Sir Leopold H. Savile: Presidential Address.

Wednesday, November 6

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (STUDENT SECTION) (at Bolbec Hall, Newcastle-upon-Tyne), at 6.45 p.m.—Mr. A. Lawson: "Marine Steering Gears".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER FOR PHYSICS AND BIOLOGY at the Queen's Royal College, Trinidad—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

ASSISTANT MASTER FOR CHEMISTRY AND PHYSICS at the Queen's College, British Guiana—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

ASSISTANT MISTRESS FOR MATHEMATICS IN MALAYA—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (November 12).

LECTURER IN GEOGRAPHY, and a LECTURER IN PHYSICS—The Registrar, Portsmouth Municipal College, Portsmouth.

PERMANENT TECHNICAL ASSISTANT and a TECHNICAL ASSISTANT IN THE DEPARTMENT OF ECONOMICS—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

LECTURER IN ENGINEERING SUBJECTS in the Department of Mechanical and Civil Engineering and Building, College of Technology and Art, Rotherham—The Director of Education, Education Offices, Rotherham.

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(*not included in the monthly Books Supplement*)

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NATURE

Vol. 146 SATURDAY, NOVEMBER 9, 1940 No. 3706

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number: City 4211

Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

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CAMOUFLAGE IN MODERN WARFARE

THE science and art of camouflage is playing, and will continue to play, a great part in the present struggle. Much progress has been made during the past twenty-five years in the establishment of certain well-defined principles of camouflage, based on research in biology and psychology. But as pointed out in NATURE of June 22, p. 949, the authorities in the various Service Departments concerned have been slow to make the most of this scientific progress ; in fact, the history of war camouflage up to that time had provided a very convincing example of the ineptitude of the system then existing, so far as science was concerned.

After examining the personnel engaged at the Civil Defence Camouflage Establishment, one could scarcely feel reassured concerning the future prospects. Of the sixty-five technical officers, all but four were either professional artists or art students. There was no biologist. It was scarcely to be wondered at, therefore, that, since there was little recruitment of authorities on biological and psychological principles, failure to achieve effectiveness was the rule rather than the exception.

This deplorable situation was also emphasized in "Science in War" (Penguin Special, S74. 6*d.* ; see also NATURE of July 27, 1940, p. 112). But after this, the scientific spirit began to show signs, though somewhat tardily, of coming into its own ; and we were glad to print evidence of this from "J. S. H." after a visit to the Civil Defence Camouflage Organization (see NATURE of October 12, p. 482). There, the experimental work is under the direct supervision of Prof. W. E. Curtis, who is assisted by a technical staff of artists, engineers, architects, chemists, physicists, photographers and a botanist.

It is useless crying over spilt milk, yet one cannot resist deploring this important enemy of efficiency—delay. Now that the research branch of this all-important problem has been accorded better foundations, the two immediate aims for the future must be still further improvements in scientific personnel and research, and the quick recognition of their value and application of their findings by all Service authorities to whom such findings may prove of even the smallest value.

So far as the first aim is concerned, it might be of advantage to the Civil Defence Station if it ensures that it is exploring all psychological principles that have an important role in camouflage, for, as Dr. H. J. Eysenck points out on p. 620 of this issue, no specialist in psychology is apparently employed at the Station. It is possible that some, if not all, of those scientific workers already employed at the Station are fully aware of such principles and have a sufficient working knowledge of psychology to apply them ; all the same, if a good specialist interested in the psychology of perception is available we suggest that he should either be placed on the research staff or invited to serve as a consultant. However, so far as the Station is concerned, it is gratifying to note, as "J. S. H." pointed out, "The art of camouflage has in the last six months gone far in utilizing scientific knowledge and scientific methods".

The second and equally important aim, namely, utilization and application of scientific method by the Services, and also co-ordination among themselves, has not hitherto been so reassuring. But the fourteenth report from the Select Committee on National Expenditure (H.M. Stationery Office. 2*d.*) which deals with this subject goes far to convince us that the Services now

realize the seriousness of the situation and that many major changes are already overdue.

It is now recognized that camouflage is both an art and a science. The discovery of means and elaboration of technique are scientific; the execution of schemes are matters requiring visual training and artistic knowledge. Men of both kinds of knowledge are therefore now being employed in research. The report, however, emphasizes chiefly that the organization of the scientific side of the matter appears to require the more urgent attention. This is due to the fact, no doubt, that until comparatively recently men of science have neither been employed nor consulted.

Several Departments are now concerned, to various degrees of urgency, with camouflage. The Ministry of Home Security is concerned with the camouflage of factories, mines, public utility undertakings, etc. This Ministry now refers to the Civil Defence Camouflage Establishment.

The Directorate of Works in the Department of the Member of the Air Council charged with supply and organization is responsible for the camouflage of aerodromes and Air Ministry buildings, and the work is administered from the Air Ministry. This branch is directed by a chief engineer with a designing staff of nine, and its work approved by the inspector of camouflage assisted by a personal assistant and two technical officers. One camouflage officer is stationed at each of fifteen Works Area Headquarters. The Royal Aircraft Establishment at South Farnborough is responsible for research. Schemes are adopted for aircraft after various tests by the Royal Air Force in consultation with the Royal Aircraft Establishment. The actual work of camouflaging aircraft and road vehicles is the responsibility of the Ministry of Aircraft Production.

The Directorate of Engineers and Signals Equipment (of the Ministry of Supply) is responsible for the camouflaging of Royal Ordnance factories, Ordnance depots and War Department buildings, guns, machine-gun posts and vehicles. Those directly responsible are two officers under the direction of the Assistant Director, who has other duties unconnected with camouflage. The Directorate refers its research to the Civil Defence Camouflage Establishment.

So far as the Admiralty is concerned, one camouflage officer is in charge of the camouflage of naval establishments. The Air Ministry is responsible for Fleet Air Arm bases. Research is referred to the Civil Defence Establishment.

The camouflage of ships has been abandoned. No doubt there are good reasons for this. The rapid development of aircraft reconnaissance at sea and the increased utilization of heavy smoke screens may have been largely responsible for rendering ship's camouflage unnecessary and, indeed, useless; yet it is to be hoped that the Admiralty authorities realize that "half the battle in science consists in asking new questions which the non-scientist cannot be expected to think of", and thus keep an open mind on, and still remain receptive concerning, this problem.

Advice on camouflage required by the Army in the field is provided by a special staff of camouflage officers attached to Corps and Divisions. The officers have been drawn from the Army and civil occupations and include two assistants from the Civil Defence Camouflage Establishment.

Even the layman has often been heard to remark that many existing examples of Service and civil camouflage are useless almost to the degree of absurdity. This is obviously fully realized now by the Services and reiterated by the Sub-Committee's report.. The broadening of research now taking place will ensure that at any rate there shall be no excuse for the continued utilization of such absurd methods. But any intelligent layman, after reading the report, would also recognize the lack of organization and collaboration extant throughout the Services. The above details of the various Services' work in this connexion should dispel any doubts. The position is far from satisfactory, and the Sub-Committee admits it.

Now that the report openly states that the execution of camouflage and research into its problems are closely bound up with each other, we are entitled to expect that complete co-ordination between research staffs and the Services will soon take effect. Each camouflage department will no longer maintain its own research staff; it is now recommended that the four departments which are responsible for the design and execution of schemes of camouflage should be concentrated in a single camouflage department with its own research staff. This is obviously all to the good, but it has the added advantage that the knowledge resulting from research would be more readily available to the executive staff. At last, the responsible authorities realize the indubitable advantages of co-ordination of research and organization, as already exemplified in scientific research by such developments as team work in universities and research associations in industry.

WELL-BEING OF MUNITION WORKERS

The Health and Efficiency of Munition Workers
By Dr. H. M. Vernon. (Oxford Medical Publications.) Pp. vii+128. (London: Oxford University Press, 1940.) 8s. 6d. net.

THE Oxford School of Physiology, founded by Burdon Sanderson, and adorned by his successors, Gotch, Sherrington, and John Mellanby, has produced many eminent men of science whose researches have benefited mankind. To industrial hygiene the contributions of the late J. S. Haldane have been important, while for many years Dr. H. M. Vernon has brought physiological knowledge and experience to bear upon the health problems of the industrial worker.

During the War of 1914–18, as investigator for the Health of Munition Workers Committee, Dr. Vernon shared in the high standard of work achieved by Prof. Major Greenwood, E. L. Collis, and others, which ameliorated the lot of the munition worker. Afterwards, he continued and extended his investigations for the Committee's successor, the Industrial Health Research Board. His studies have covered many subjects in this field, such as industrial fatigue and efficiency, the output of munition workers in relation to hours of work, alcohol and industrial efficiency, ventilation and heating in factories, etc., all studies which are not only of scientific interest, but also are of vital importance to employers and those employed in industry.

Last year, Dr. Vernon garnered the fruits of these years of patient investigation in a volume entitled "Health in Relation to Occupation" (see NATURE, July 6, p. 6). This work showed that, as a rule, ill-health is due only in a moderate degree to the direct effects of occupation. "Social environment, including nutrition," he writes, "has much more powerful effect, whilst hereditary influences, especially intelligence, are also very powerful." Dr. Vernon admitted that it was still a difficult problem to ascertain the relative degrees of importance to be attached to the three factors mentioned, but he rightly claimed that his book summarized existing knowledge and pointed out the directions in which further information is required. To-day, we are once more in the thick of a great war, and are again dependent—and with the advance made in destructive instruments of warfare even more dependent than twenty-five years ago—upon munition workers for our national security.

It is fortunate and timely, therefore, that Dr. Vernon has followed up his more general book of last year with a monograph devoted to "The Health and Efficiency of Munition Workers". His extensive knowledge of the subject makes this book an important contribution to national effort. Every day for the last six months come demands for more aeroplanes, more guns, more tanks, more ammunition, more destructive weapons of all kinds. Factories spring up like mushrooms all over the country, and workers flock into them whose enthusiasm must be guided and controlled by skilled training and direction, and, above all, by the rules of health. Otherwise, there will be waste of effort, diminished efficiency and output, and wastage of man-power due to accidents and ill-health.

The conditions under which munition industries are conducted should be so arranged that the workers can retain their fitness and vigour. As Dr. Vernon observes, the workers' sense of patriotism undoubtedly stimulates them to work harder than in peace-time. This incentive must, however, be applied with discretion, both by the employers and the employed, for otherwise it will defeat its chief object. Grievous errors made in this respect in the earlier stages of the War of 1914–18 had to be remedied and overtaken by the recommendations of the Health of Munition Workers Committee, and although much time has been devoted in the intervening years to studying the best ways of promoting industrial health and efficiency, as recent experience has shown, it cannot be assumed that the past errors will be altogether avoided without due care and foresight. Many employers and managers of industrial establishments have no special knowledge about industrial health and its maintenance, and they need to be reminded of the precautions which ought to be taken.

The present little book covers succinctly the essentials of the problem. It treats of hours of work, work spells and rest pauses, and shift systems, including day and night shifts. Dr. Vernon wisely drives home the lesson, which employers of labour have been slow to learn, that to over-drive the human machine damages the health of the individual worker, and is bad business for the employer, because the worker's output and efficiency deteriorate with long hours of labour. Yet so far back as 1816 Robert Owen discovered that when he ran his New Lanark mills for 10½ hours a day instead of the usual 15–16 hours a day, output did not fall sensibly below its previous level.

The more medical chapters of the book discuss sickness and absenteeism, and accidents and injuries. This brings up the question of rehabilitation of the industrial worker, to which

considerable thought is being given at the present time.

There is a useful chapter on the ventilation, heating, and lighting of factories, and the influence of noise on efficiency. The book concludes with a concise account of welfare and labour management.

We have two points of criticism. One is that the author might have emphasized more strongly the importance of linking up the medical and care work of the factory with the national health services, for the munition worker has a social environment as well as an occupational one. Although Dr. Vernon devoted considerable space to this matter in his previous book, a reminder here would have been advantageous. The other point is that this book with such a wide appeal might have been published at a lower price, even in these difficult times. It should be read by every employer of munition workers, and a copy should be placed in every works library.

A. S. MacNalty.

MARXISM IN HISTORY EXPOSED

The Materialist Conception of History
A Critical Analysis. By Karl Federn. Pp. xiv+263. (London: Macmillan and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THIS is the most admirable exposé of the fallacies of the materialist conception of history that I have ever come across. The author, who is a Viennese in exile, has taken the trouble to go through the fifteen propositions in the introduction to Marx's "Criticism of Political Philosophy" written in London in 1859 and other Marxist writings, and tried to sift out any grains of truth there may be in them. Dr. Federn is a historian apparently familiar with both ancient and modern times, and he writes with impartiality and in a clear and very attractive style. The style indeed is so good that one wonders that any foreigner should have been capable of writing it. But, as no name of a translator is given, one supposes that the author is as perfect a linguist as he is undoubtedly a wide and accomplished historian.

It is much to be hoped that the book will be largely circulated, for the fallacies which it exposes are much in vogue with the non-historical younger part of our people at the present moment, and the serious historian rarely turns out of his path to expose them. That is why we should be particularly thankful to Dr. Federn for having done it, and done it so conclusively that no one who takes the trouble to read the book and can understand the meaning of a simple sentence, would ever again be confused by the sophistries of material dialecticism.

One can only give in a few sentences the general gist of the book. Marx maintains in one of the fifteen propositions referred to above that the "conditions of production", namely, the economic structure of society, determine all the superstructure, that is, the laws, the science, the religion, the art of every age. Dr. Federn's answer comes briefly to two propositions. One, that in every age the conditions of production, that is, how mankind at that time make their living, will undoubtedly have some effect on the way they think and act in other matters, but that this influence is only one of a mass of influences on our thought which are too numerous and subtle to be summarized in any such statement. Indeed to find the relations of the economic and other conditions in any one historical period is often more than the work of a lifetime. Second, that the Marxist view derives almost entirely from a consideration of the last hundred or two years. The farther back we go the less clear is the connexion and the more inadequate is Marx's knowledge of what has been discovered. Thus prehistory does not exist for him, and he sweeps all the hundreds of thousands of years of human history before the civilization which he calls "Antique" into the one incomplete and misleading formula, that the conditions of production, that is, the economic side of history, determine everything.

Dr. Federn really disposes of the whole sophistical structure in one of his earlier sentences: "Discovering a new productive force as well as finding out a method of applying it are mental acts. If this were not the case, if there were no need of intelligence to discover and employ the forces of nature, the animals would discover and employ them also and the inferior races would develop a civilization as quickly as the higher".

The moral is, what generations of better historians than Marx have long known and explored, that mind and not matter rules the world. The use and charm of Dr. Federn's book is that a deeply read historian has traced the fallacy through all the main stages of human civilization without writing a dull or unnecessary word.

It is much to be wished that the book in some form should become available for all students and teachers of history.

F. S. Marvin.

FARMING AS A BUSINESS

Farm Management
In-going and Out-going, Insurance, Income Tax, Credit and Farm Records. By K. W. D. Campbell. Pp. 156. (London: English Universities Press, Ltd., 1940.) 8*s*. 6*d*. net.

THIS book is frankly a disappointment, for a good text-book dealing with the principles of farm management has long been needed.

Farming has been called a science, an art, a business and a way of life. In fact, as Prof. Scott Watson says in his foreword, it is all of these. But it is only within the last twenty years that the importance of teaching the business side of the subject has begun to be realized. There was a time when it was thought sufficient to teach the agricultural student science and science only, ignoring the art. But it soon became evident that a purely scientific training was wholly inadequate, and in spite of much of what had once been exclusively an art having been converted to a science, yet a great deal of the art still remained and showed no sign of ever being reduced to scientific form. Science can be taught in lecture room and laboratory, but the practical art of husbandry can be taught only on the farm itself. Hence the necessity for university and college farms. But the matter did not end here, for it appeared that even a combination of science and art were not enough. No amount of scientific knowledge will compensate for a lack of business ability, and no amount of technical skill will ensure the success of a farm judged as a business. Hence the growing recognition of the need for including teaching in the business aspects of the subject in the agricultural student's curriculum.

One of the difficulties of developing this side of agricultural education has been the want of suitable text-books. It is therefore most unfortunate that the first book of the kind should be published at such a time as this, for the book under notice was planned, as the author explains, only as the first part of a comprehensive work on the subject of farm management, a task the completion of which the advent of the War made impossible. But it is incomprehensible why for the first volume the author should have singled out the particular aspects of farm management that he has. In-going and out-going, insurance, income tax, credit, etc.; the list is not inspiring, and includes subjects a knowledge of which is certainly desirable, but few of which can be said to have much educational value.

The book imparts a mass of information on a number of incredibly dull subjects, information which no doubt is correct to-day but all of which may be changed to-morrow. It deals with facts rather than with principles; it is informative rather than educational. It is a book that may be of value to the farmer and even to the agricultural student for reference purposes, but it is certainly one that will never be read from interest.

Parts of the book, however, indicate that the author is capable of other and better things, and that if only he would deal with the fundamental principles of farm management rather than with detail, a book of permanent value might result. The chapter on choosing a farm is an example, though even this chapter is open to criticism, for the author draws no clear distinction between inherent fertility and condition. This is the more important in that the two are always liable to be confused in the student's mind.

Let us hope that when the second part of the book comes to be written the author will deal with the subject in a different way, a way in which he has already shown himself to be capable.

WILFRID MANSFIELD.

THE HISTORY OF JERICHO

The Story of Jericho
By John Garstang and J. B. E. Garstang. Pp. xv+200. (London: Hodder and Stoughton, Ltd., 1940.) 8*s*. 6*d*. net.

IN Old Testament history the fall of Jericho is the culmination of a long drawn-out drama which has impressed itself upon the imagination of most generations of men—and not Israelites alone. In archæology the excavations on the site of the city which have been carried out by Prof. John Garstang over a period of years have set the development of early civilization in Palestine in a new and arresting perspective. Not only do we now see the beginning of those relations with the two great empires lying on either side which were to have a decisive effect on the growth and influence of Palestine in history, but we also are carried back unexpectedly to the earliest known settlement of man in Palestine, or it may be indeed as Prof. Garstang remarks, one of the oldest "in the whole world". In the north-east corner of

the walled enclosure the remains of late stone age buildings deep below the foundations of the walled city proved to be the latest of a series of neolithic deposits which led down, stage by stage, to a further depth of 23 ft., evidence of a long and peaceful occupation and development. Beneath these, at a depth of 6 ft. below the Bronze Age walls of 3000 B.C., were evidences of the earliest settlers in the form of primitive and, generally, pygmy flint implements, seemingly characteristic of the mesolithic period, and as such comparable with the culture of the inhabitants of the caves of Mount Carmel discovered in her excavations by Prof. Dorothy Garrod. To this early settlement a tentative dating of some period before 5000 B.C. is assigned. The earliest or lower neolithic falls at 4500 B.C., contemporary with the Proto-Chalcolithic period of Mersin in Cilicia, recently also excavated by Prof. Garstang himself. He points out that while these early neolithic settlements are to be regarded as of local origin and growth, in Palestine as at Mersin there is an early development of architectural features. Especially noteworthy at Jericho is the appearance of a megaron-like temple and the practice of burnishing the plastered walls and floors. It is also worthy of special remark that pottery first appears in the Middle Neolithic period, and in forms which Prof. Garstang interprets as pointing to independent invention. This period, which is purely stone age, is contemporary with the early Chalcolithic of northern Mesopotamia. It has distant cultural affinities with Tepe Zawra, Ras Shamra and the Fayoum, but shows a characteristic time lag.

In the six seasons of excavation which were devoted to the examination of the site, evidence of four successive cities was brought to light. Of these the earliest dates from the Early Bronze Age of 3000 B.C., pre-dynastic Egyptian object appearing beneath its foundations, but with Babylonian art and religious influence dominant within its period. In the Middle Bronze Age (2000 B.C.) the Canaanites appear, but later (1750 B.C.) it becomes a Hyksos fortress until 1600 B.C. when the city was totally destroyed at the time the Egyptians drove out the Hyksos and established the New Empire. Thenceforth until the fall of the city, which Prof. Garstang argues must have taken place in the reign of Amenhotep III, *c.* 1390 B.C., Palestine was under Egyptian domination, although there is evidence to show that at the period of the Hebrew invasion it was passing through a phase of decadence.

Prof. Garstang in this review of the material upon which he has reported in detail from time to time elsewhere, has in view the interests of the reader to whom the appeal of the archæological data is subservient to the solution of the problem presented by the Biblical narrative—"Why and how did Jericho fall?" When all the evidence to be gathered from examination of the site has been presented in outline, Mr. J. B. E. Garstang takes up the story and shows how all the different classes of evidence which can be brought to bear converge to show that the Exodus, including the Plagues, the drying up of the Red Sea, and the incidents of the sojourn in the wilderness, as well as the fall of the walls of the city, is to be attributed to a period of intense volcanic activity culminating in a violent earthquake, to which the records show that the rift in which Jericho is situated has always been subject. The latest serious recurrence which reproduced features mentioned in the biblical narrative took place so recently as 1927.

PROBLEMS OF THE VIRUS

The Virus

Life's Enemy. By Kenneth M. Smith. (Cambridge Library of Modern Science.) Pp. viii + 176 + 9 plates. (Cambridge: At the University Press, 1940.) 7*s.* 6*d.* net.

THE present time is ripe for a general review of the problems of virus diseases elucidated during the last decade, and Dr. Kenneth Smith has recognized the opportunity by writing this volume. He is an accepted authority on plant viruses, but this latest work does not confine its allegiance to the plant kingdom. It is a conspectus of virus phenomena, and draws authoritative illustrations with equal facility from animal and plant diseases. One good effect of this is to show the essential similarity of virus upon both types of host; a worker in plant viruses investigates the same principles which present themselves from the animal side. The first part of the volume discusses the nature of virus; how it was discovered, how it is studied, and what is its nature. Part 2, "The Virus in Action", discusses methods of infection and the action of virus upon the living cell. It is this section, and that which outlines a range of the more important virus diseases, which justify the volume's sub-title "Life's Enemy". A chapter on control of these maladies is also added, and Dr. Smith's specialist studies of the entomological implications of virus diseases make fascinating reading, for the relations of a virus with its insect vector have a tantalizing complexity.

The range of diseases outlined in the volume is necessarily not extensive ; it is the author's design to parade the various types of host before the reader, and accordingly typical diseases of man and domestic mammals, of birds, fish, plants and bacteria are described. A very interesting discussion is given of the relations of viruses with malignant tumours, and it is good to see that scientific investigation is again directed to this possibility. The peculiar action of virus upon living cells is considered. The parasite can stimulate or destroy the cell, and it may vary in its effects, even to the production of a new type of disease. Nineteen excellent plates portray symptom-complexes which are relatively common.

Dr. Smith considers that the virus is probably rather more inanimate than living, because of the recent work upon the crystalline nature of virus protein. He is, however, perhaps a little too definite when he says, in answer to the question "Are viruses living or non-living ?" that "This starts a hare which can never be caught" (p. 37). The question is indeed difficult ; but is not impossible of solution. Evaluation of all incompletely determined phases of the problem is quite fair, however, and the author takes pains to give both sides of the question, where two exist.

Clarity and simplicity of expression render this treasury of information available to the general reader. This is a book which could only have been written by a master of the subject ; it is rich in the intangible value of background ; it can be read with pleasure in its expression, for it is a contribution to general culture, but it has also the full merit of an exact scientific review.

J. Grainger.

CHEMICAL CHANGE

The Kinetics of Chemical Change
By Dr. C. N. Hinshelwood. Pp. vii+274. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 15*s*. net.

PROF. HINSHELWOOD'S first book on chemical change appeared in 1926 and later ran into three editions. There is little doubt that a fourth edition would have been welcomed as eagerly as its predecessors were ; but the author has adopted the heroic course of writing a new book instead of expanding the old. It would be an under-statement to state that the result is satisfactory—that was to be anticipated ; the treatment of the subject in the present volume is by far the most satisfactory and interesting that has yet been written.

In the kinetics of chemical change the energy of activation is the fundamental factor that is involved, and is at present the one quantity which has to be determined by experiment, although in simple cases, as shown by Eyring and by Shermann, it is possible to calculate the value from molecular dimensions and band spectra values.

Apart from this problem of the energy of activation, there are in general three methods of approach to gas reactions : the kinetic, the statistical and that of the transition state. It is important to realize the assumptions which have to be made or are tacitly assumed in each method of treatment so as to obtain formal agreement both with each other and with the experimental data. It is a much more difficult matter to decide whether they all do, in fact, portray the same molecular mechanism of reaction and, if so, that the one they do describe is the correct one. For example, we might regard the mechanism of reaction between two molecules as involving on one hand a steady but decelerated mutual approach during which the valency bonds undergo any necessary continuous change in orientation before the quasi-equilibrium of the transition state is attained, or on the other hand we might regard the mechanism as more akin to the dropping of a glass object on a hard surface—at a critical velocity of impact with the correct orientation the glass breaks. As an alternative simile we might contrast a photochemical change at the threshold of the continuous spectrum with one in which a jump to a new level of excitation is involved.

Some four chapters are devoted to gas reactions, and although these comprise only one hundred pages of text, there is scarcely a point of interest or importance which has been left out. It is admittedly difficult to distinguish experimentally between a unimolecular reaction obeying the Lindemann mechanism and one involving short chains. To accept the usual criterion of change in the velocity constant with the pressure is dangerous when more than one reaction mechanism is involved ; thus to account for the decomposition of azo-isopropane on the unimolecular basis it must have at 150° C. a specific heat of some 40–50 calories. This seems a large value, and further work on specific heats of this and similar substances is clearly desirable.

In contrast to the reactions in homogeneous phases, the author devotes only some fifty-five

pages to heterogeneous reactions. Whilst the difference between chemi-sorption and physical or van der Waals' adsorption is mentioned, it is debated whether there is a true distinction between the two kinds. Many now would take the view that catalytic reactions function because both kinds of adsorption are involved and that the act of catalysis involves a switch-over of the 'adsorbed' constituents from one type to another.

In the last chapter several general aspects of chemical change are discussed, of especial interest being the section on a comparison of reactions in the gaseous state with those in solution.

The author is to be congratulated on a magnificent achievement. In the preface he states that it is written for anyone who cares to read it; the reviewer might add, anyone who cares to read it will read it again and again. ERIC K. RIDEAL.

HISTORY OF LABORATORY APPARATUS

The Tools of the Chemist

Their Ancestry and American Evolution. By Ernest Child. Pp. 220. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 21s. net.

IF it be true, as has often been emphasized, that scientific progress is associated with the development of new laboratory methods and technique, then the story of laboratory apparatus becomes a part of the history of chemical education. This is a special branch of historical chemistry so it requires close contact with the instrument business for its investigation; the author, long associated with Eimer and Amend of New York, has proved fully capable of discharging his self-assumed task. Though limited to American chemistry, Mr. Child has necessarily gone back to European origins so as to place his picture in its proper setting. The resulting story, briefly told in an attractively produced book, makes the most pleasant reading: we would recommend its perusal to our colleagues.

Sellers of scientific apparatus are not to be regarded as mercenary and tainted with commercialism. The great Gay-Lussac founded with Collardeau a firm for the manufacture of the burette, vapour density and other apparatus he had originated. Accum, a gentleman of whom there are two opinions to-day, declared "that he who establishes a place of fabrication of an article of use to the sciences is a benefactor to the public".

American chemists, like the British, were too dependent, prior to 1914, upon Continental manufacturers and dealers for much of their scientific equipment. Hundreds of chemists who became future leaders studied in Continental laboratories and on their return home naturally ordered the apparatus with which they were familiar. The implications of this sentence might well be pondered over for the future: Britain must see to it that after the War she attracts students from both the Americas, the Dominions, the East, and even from the Continent, that besides teaching them science they are also inculcated with British ideals and the habit of buying British. This form of propaganda is both necessary and justifiable, and might properly form an activity of the British Council.

America, of course, owes much to its emigrants, skilled mechanics from England, Holland and France, while as a result of the political disturbances of 1848 many glassblowers and instrument makers came from Germany.

The text is divided into three sections, the first headed "People and Events", the second entitled "Ancestry and Development", whilst the third gives the history of the distributors of apparatus in America. The first recorded importation of apparatus and chemicals into North America was made by John Winthrop in 1633; the cradle of American laboratory apparatus was in Philadelphia, where thermometers and hydrometers and "glasses for Philosophical Experiments" were made so far back as 1785.

Mr. Child has a happy knack of mixing past and present, and is clever in selecting his illustrations and quotations.

In days when there is serious discussion in the columns of NATURE of curtailing the practical course in school training in science, it is worth while quoting a philosophy expressed in the eighth century by Jābir ibn Ḥayyān, the great chemist of Islam. "The first essential in chemistry is that thou shouldst perform practical work and conduct experiments." This is as true to-day as when it was written; it applies above all to schools. We fail to-day because we are not a practical nation; nine tenths of us in the towns are unable to use our hands. We are trained to fill in forms and not to work lathes, so that most of us are helpless when emergency arises. The same philosopher also says, "But thou, oh my son, do thou experiment so that thou mayest acquire knowledge". It is in the laboratory that progress is made; the chemist must look to it that his tools are ready.

We thank Mr. Child for a delightful book.

E. F. ARMSTRONG.

SCIENCE AND RELIGION*

By Prof. Albert Einstein, For.Mem.R.S.

It would not be difficult to come to an agreement as to what we understand by science. Science is the century-old endeavour to bring together by means of systematic thought the perceptible phenomena of this world into as thorough-going an association as possible. To put it boldly, it is the attempt at the posterior reconstruction of existence by the process of conceptualization. But when asking myself what religion is, I cannot think of the answer so easily. Even after finding an answer which may satisfy me at this particular moment, I still remain convinced that I can never in any circumstances bring together, even to a slight extent, all those who have given this question serious consideration.

At first, then, instead of asking what religion is, I should prefer to ask what characterizes the aspirations of a person who gives me the impression of being religious: a person who is religiously enlightened appears to me to be one who has, to the best of his ability, liberated himself from the fetters of his selfish desires and is preoccupied with thoughts, feelings, and aspirations to which he clings because of their super-personal value. It seems to me that what is important is the force of this super-personal content and the depth of the conviction concerning its overpowering meaningfulness, regardless of whether any attempt is made to unite this content with a Divine Being, for otherwise it would not be possible to count Buddha and Spinoza as religious personalities. Accordingly, a religious person is devout in the sense that he has no doubt of the significance and loftiness of those super-personal objects and goals which neither require nor are capable of rational foundation. They exist with the same necessity and matter-of-factness as he himself. In this sense religion is the age-old endeavour of mankind to become clearly and completely conscious of these values and goals, and constantly to strengthen and extend their effects. If one conceives of religion and science according to these definitions, then a conflict between them appears impossible. For science can only ascertain what is, but not what should be, and outside its domain value judgments of all kinds remain necessary. Religion, on the other hand, deals only with evaluations of human thought and action; it cannot justifiably speak of facts and relationships between facts. According to this interpretation, the well-known conflicts between religion and science in the past must all be ascribed to a misapprehension of the situation which has been described.

For example, a conflict arises when a religious community insists on the absolute truthfulness of all statements recorded in the Bible. This means an intervention on the part of religion into the sphere of science; this is where the struggle of the Church against the doctrines of Galileo and Darwin belongs. On the other hand, representatives of science have often made an attempt to arrive at fundamental judgments with respect to values and ends on the basis of scientific method, and in this way have set themselves in opposition to religion. These conflicts have all sprung from fatal errors.

Now, even though the realms of religion and science in themselves are clearly marked off from each other, nevertheless there exist between the two strong reciprocal relationships and dependencies. Though religion may be that which determines the goal, it has, nevertheless, learned from science, in the broadest sense, what means will contribute to the attainment of the goals it has set up. But science can only be created by those who are thoroughly imbued with the aspiration towards truth and understanding. This source of feeling, however, springs from the sphere of religion. To this there also belongs the faith in the possibility that the regulations valid for the world of existence are rational, that is, comprehensible to reason. I cannot conceive of a genuine man of science without that profound faith. The situation may be expressed by an image: science without religion is lame, religion without science is blind.

Though I have asserted above, that in truth a legitimate conflict between religion and science cannot exist, I must nevertheless qualify this assertion once again on an essential point, with reference to the actual content of historical religions. This qualification has to do with the concept of God. During the youthful period of mankind's spiritual evolution, human fantasy created gods in man's own image, who, by the operations of their will, were supposed to determine, or at any rate to influence, the phenomenal world. Man sought to alter the disposition of these gods in his own favour by means of magic and prayer. The idea of God in the religions taught at present

* From a written communication to the Conference on Science, Philosophy and Religion recently held at the Jewish Theological Seminary of America, New York.

is a sublimation of that old conception of the gods. Its anthropomorphic character is shown, for example, by the fact that men appeal to the Divine Being in prayers and plead for the fulfilment of their wishes.

Nobody, certainly, will deny that the idea of the existence of an omnipotent, just and omni-beneficient personal God is able to accord man solace, help, and guidance ; also, by virtue of its simplicity the concept is accessible to the most undeveloped mind. But, on the other hand, there are decisive weaknesses attached to this idea in itself, which have been painfully felt since the beginning of history. For example, if this Being is omnipotent, then every occurrence, including every human action, every human thought, and every human feeling and aspiration is also His work ; how is it possible to think of holding men responsible for their deeds and thoughts before such an Almighty Being ? In giving out punishment and rewards He would to a certain extent be passing judgment on Himself. How can this be combined with the goodness and righteousness ascribed to Him ?

The main source of the present-day conflicts between the spheres of religion and of science lies in this concept of a personal God. It is the aim of science to establish general rules which determine the reciprocal connexion of objects and events in time and space. For these rules, or laws of Nature, absolutely general validity is required —not proven. It is mainly a programme, and faith in the possibility of its accomplishment in principle is only founded on partial successes. But scarcely anyone could be found who would deny these partial successes and ascribe them to human self-deception. The fact that on the basis of such laws we are able to predict the temporal behaviour of phenomena in certain domains with great precision and certainty, is deeply embedded in the consciousness of the modern man, even though he may have grasped very little of the contents of those laws. He need only consider that planetary courses within the solar system may be calculated in advance with great exactitude on the basis of a limited number of simple laws. In a similar way, though not with the same precision, it is possible to calculate in advance the mode of operation of an electric motor, a transmission system, or of a wireless apparatus, even when dealing with a novel development.

To be sure, when the number of factors coming into play in a phenomenological complex is too large, scientific method in most cases fails us. One need only think of the weather, in which case prediction even for a few days ahead is impossible. Nevertheless, no one doubts that we are confronted with a causal connexion the causal components of which are in the main known to us. Occurrences in this domain are beyond the reach of exact prediction because of the variety of factors in operation, not because of any lack of order in Nature.

We have penetrated far less deeply into the regularities obtaining within the realm of living things, but deeply enough nevertheless to sense at least the rule of fixed necessity. One need only think of the systematic order in heredity, and in the effect of poisons, as, for example, alcohol on the behaviour of organic beings. What is still lacking here is a grasp of connexions of profound generality, but not a knowledge or order in itself.

The more a man is imbued with the ordered regularity of all events, the firmer becomes his conviction that there is no room left by the side of this ordered regularity for causes of a different nature. For him neither the rule of human nor the rule of Divine Will exists as an independent cause of natural events. To be sure, the doctrine of a personal God interfering with natural events could never be *refuted*, in the real sense, by science, for this doctrine can always take refuge in those domains in which scientific knowledge has not yet been able to set foot.

But I am persuaded that such behaviour on the part of the representatives of religion would not only be unworthy but also fatal. For a doctrine which is able to maintain itself not in clear light but only in the dark will of necessity lose its effect on mankind, with incalculable harm to human progress. In their struggle for the ethical good, teachers of religion must have the stature to give up the doctrine of a personal God, that is, give up that source of fear and hope which in the past placed such vast power in the hands of priests. In their labours they will have to avail themselves of those forces which are capable of cultivating the good, the true, and the beautiful in humanity itself. This is, to be sure, a more difficult but an incomparably more worthy task. (This thought is convincingly presented in Lord Samuel's book, "Belief and Action".) After religious teachers accomplish the refining process indicated, they will surely recognize with joy that true religion has been ennobled and made more profound by scientific knowledge.

If it is one of the goals of religion to liberate mankind so far as possible from the bondage of egocentric cravings, desires and fears, scientific reasoning can aid religion in yet another sense. Although it is true that it is the goal of science to discover rules which permit the association and foretelling of facts, this is not its only aim. It also seeks to reduce the connexions discovered to the smallest possible number of mutually independent conceptual elements. It is in this striving after the rational unification of the manifold that

it encounters its greatest successes, even though it is precisely this attempt which causes it to run the greatest risk of falling a prey to illusions. But whoever has undergone the intense experience of successful advance made in this domain is moved by profound reverence for the rationality made manifest in existence. By way of the understanding he achieves a far-reaching emancipation from the shackles of personal hopes and desires, and thereby attains that humble attitude of mind towards the grandeur of reason incarnate in existence which, in its profoundest depths, is inaccessible to man. This attitude, however, appears to me to be religious in the highest sense of the word. Thus it seems to me that science not only purifies the religious impulse of the dross of its anthropomorphism, but also contributes to a religious spiritualization of our understanding of life.

The further the spiritual evolution of mankind advances, the more certain it seems to me that the path to genuine religion does not lie through the fear of life, and the fear of death, and blind faith, but through striving after rational knowledge. In this sense, I believe that the priest must become a teacher if he wishes to do justice to his lofty educational mission.

MOLECULAR FIELDS OF FORCE: RETROSPECT AND SUGGESTIONS

By Prof. Sydney Chapman, F.R.S.,

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In the nineteenth-century development of the kinetic theory of gases, the molecules were at first usually treated as solid spheres like billiard balls, differing in size and mass. This molecular model, though it furnished a conveniently simple picture of many gas phenomena, nevertheless represented a retrogression from the model discussed long before by Boscovich[1], who regarded atoms as centres of force, varying with the distance r both in intensity and sign.

Maxwell[2], in 1867, made a partial return to the Boscovich model, when he gave the first mathematically accurate theory of the mean free-path phenomena of gases (namely, viscosity, conduction and diffusion), for a gas whose molecules interact according to the inverse fifth power of the distance, r^{-5}. This special law was chosen because its consequences are relatively easy to work out, within the brilliantly conceived framework of Maxwell's general method; not until 1915 was it found possible to adapt this framework so that any law of variation of the force $f(r)$, with the distance r, could be dealt with[3]. Soon afterwards the same results were achieved by Enskog[4], who overcame equal difficulties in generalizing a method due to Boltzmann, itself inspired by the work of Maxwell.

Meanwhile, in 1873, van der Waals[5] improved the solid-sphere molecular model by adding to it a field of attractive force; on this basis he developed his famous equation of state, the first great advance on the ideally simple Boyle-Charles law. Sutherland[6], in 1893, used the same model in connexion with the theory of gaseous viscosity.

Enskog and I, in our general theories of the mean free-path phenomena, dealt particularly with the simple force-law $f(r) \propto r^{-n}$, and with the van der Waals model. Lennard-Jones[7] first applied the theory to molecules of the Boscovich type, by taking $f(r) = Kr^{-m} + K'r^{-n}$; the first term represents the repulsive forces at short distances, and the other (if $K' < 0$) the attractions at long distances. He also calculated the equation of state for a gas composed of such molecules, and used both types of data (and others) to determine the force constants K, K' and the force indices m, n. He found that except in the case of hydrogen and helium neither the equation of state nor the viscosity determines the molecular field uniquely; for other gases the two methods permit a range of possible models (or values of K, K', m, n), and other methods have to be used to narrow this range.

The ambiguity of the models inferred by Lennard-Jones extends even to the sign of K', that is, it remains uncertain whether the distant field is attractive or repulsive[8]. Hence for many gases his formula for $f(r)$ may be regarded only as a means of indicating a change of the index of the repulsive field at moderate distances, instead of as representing the undoubted attraction at larger distances. If n itself is taken to be a function of r, any function $f(r)$ may be expressed as Kr^{-n}, over any range of r for which f has a constant sign; and $n = -d \log f(r)/d \log r$. For a particular temperature or range of temperature the important range of r at collisions will correspond to certain

average values of K and n, and these values can be found as described, using formulæ based on the law $f(r) = Kr^{-n}$ (n constant); but K and n as thus determined will in general vary with the temperature.

Such methods of determining molecular fields of force, though based on accurate mathematical theories, are empirical in the sense that the theories merely indicate the observable consequences implied by the adoption of particular molecular models, and thus enable us, by comparing the theoretical results with experimental data, to infer more or less satisfactory models consistent with the data.

A more fundamental approach to the study of intermolecular fields is possible, by calculating them from the electronic structure of the molecules. The first step in this direction was taken in 1927 by Heitler and London[9], who applied the quantum theory to calculate approximately the interaction between two hydrogen atoms. Their theory accounted for the repulsion at small distances; in 1930 Eisenschitz and London[10] carried the calculation to a further approximation, and accounted also for the van der Waals force at large distances. The magnitude of this force was found with great accuracy, but the value of $f(r)$ for *atomic* hydrogen has comparatively little practical importance. The same methods have been applied also to helium atoms, and in this way Slater and Kirkwood[11], and later Buckingham[12], have obtained results in good agreement with one another and with the form of $f(r)$ determined empirically by Lennard-Jones. Calculations have also been made for other atoms, in reasonable agreement with observation.

For molecules the task is much more difficult; Massey and Buckingham[13] have made a beginning by calculating the long-range forces between hydrogen molecules. These forces will depend both on the distance r between the molecular centres, and on the orientation of their two axes relative to the line of centres, because the hydrogen molecule is not spherically but axially symmetrical. But Massey and Buckingham point out that in hydrogen at ordinary temperatures the time of complete revolution of a molecule is of the same order as the time of a collision, so that it is reasonably legitimate to average the interaction over all orientations; this gives the function $f(r)$ effective in gas kinetics, as if the molecules were spherically symmetrical.

Massey and Buckingham express the hope that they will be able to extend their calculations on the hydrogen molecule to include also the short-range forces, and thereafter to calculate the equation of state of hydrogen, and its viscosity, without recourse to empirical methods. But the day still seems far distant, as Fowler and Guggenheim remark in their "Statistical Thermodynamics" (p. 276), when such calculations will be a practical possibility, at least for molecules other than hydrogen. Hence our knowledge of molecular fields must for the present rest largely on their empirical determination from observed data.

An avenue to such knowledge, different from that followed by Lennard-Jones, and hitherto but little unexplored despite its promise, is afforded by the phenomenon of thermal diffusion[4,7], which is particularly sensitive to the nature of the molecular interaction. When a mixture of two gases (1, 2) is enclosed in a vessel, of which different parts are maintained at different (absolute) temperatures T, T', small differences of relative concentration are set up. The concentration difference is given approximately by $k_T \log_e(T'/T)$, where k_T, the thermal diffusion ratio, depends in a complicated way upon the mass-ratio and concentration-ratio and the three laws of interaction between either type of molecule (1,1 or 2,2), or between the two types (1, 2). Experiments in which k_T is determined have been made for many gas mixtures, by Dootson, Ibbs[14], Elliott and Masson, Lugg, Blüh, Nier and other workers; but the inferences drawn from these experiments, mainly as to the nature of the interaction between the unlike molecules, have hitherto been rather rough, partly owing to the complexity of the theoretical expression for k_T. It seems desirable, and through the great advance in our knowledge and use of isotopes it is now possible, to apply thermal diffusion more simply to the elucidation of intermolecular forces; this would also enable the considerable amount of existing thermal diffusion data to be interpreted better than is yet possible.

It is generally supposed, and the view is reasonably consistent with experimental data on viscosity, that the law of interaction $f(r)$ between two like molecules M is the same as that between M and an isotopic molecule M', or between two such molecules M'; for example, M may be H_2 and M' may be D_2, or M may be $C^{12}H_4$ and M' may be $C^{12}H_3D$ or $C^{13}H_4$. If this be so, the force-index n in the approximate expression $f(r) = Kr^{-n}$ may be determined from the equation of state or from the temperature variation of the viscosity; but a more delicate way of determining n is by thermal diffusion experiments on a mixture of the isotopic molecules, as has been done for $C^{12}H_4$ and $C^{13}H_4$ by Nier[15]. After n has been thus determined —and this can be done to a fraction of an integer, instead of with an uncertainty of one or more whole integers (as when viscosity data are used)—the corresponding value of K can best be determined from viscosity data at any particular temperature.

There is scope for a large amount of useful experimental work of this kind, especially in cases where more than one isotope is available, and particularly when one or more of these is radioactive. As an example, the case of hydrogen may be cited; it has two non-radioactive types of atom, H^1 (or H) and H^2 (or D), and one radioactive isotope H^3. O'Neal and Goldhaber[16] have lately shown that the half-lifetime of H^3 is 31 ± 8 years, so that this isotope is conveniently long lived. From these three isotopes six types of hydrogen molecule may be formed, namely, H_2, HD, D_2 (all non-radioactive), and HH^3, DH^3 and H^3H^3 (all radioactive); the last of these, however, is at present unlikely to be available in sufficient quantity for use in experiments. The remaining five types of hydrogen molecule provide ten different possible isotopic hydrogen mixtures, namely, (*a*) H_2–HD, (*b*) H_2–D_2, (*c'*) H_2–HH^3, (*d'*) H_2–DH^3, (*e*) HD–D_2, (*f'*) HD–HH^3, (*g'*) HD–DH^3, (*h'*) D_2–HH^3, (*i'*) D_2–DH^3 and (*j''*) HH^3–DH^3. The accent (′) in this enumeration indicates radioactivity in one or both components of the mixture; in such mixtures the radioactive molecules can at present be available only as very rare constituents, and therefore the last mixture, (*j''*), in which both constituents are rare, may be excluded from consideration. This leaves nine hydrogen mixtures available for thermal diffusion experiments. Those containing a rare radioactive constituent are very suitable for this purpose, as I pointed out in 1929[17], because of the delicacy of radioactive estimations; the difficulties which led to a high probable error in the half-lifetime of H^3, in the determination by O'Neal and Goldhaber, would not arise in thermal diffusion experiments; the temperature conditions can be maintained steady for a long time, and long-continued Geiger counts would permit the ratio of the concentration of the rare constituent in the two regions at different temperatures to be determined with considerable accuracy.

The nine hydrogen mixtures include one pair, (*h'*), or D_2–HH^3, in which the molecular masses are almost exactly equal; any thermal separation found for this pair (subject to a minute correction for the proportionate mass-difference $m \equiv (m_1 - m_2)/(m_1 + m_2)$, which is 5/8055) must be due to a slight inequality of the interactions between the D_2–D_2 and D_2–HH^3 molecular pairs; this provides a very delicate test of the supposition, already mentioned, that the force fields are identical for isotopic molecules.

For two pairs of the nine gas mixtures, namely, (*b*) and (*c'*), and (*e*) and (*f'*), the proportionate mass-differences m are almost identical, namely, $\frac{1}{3}$ and $\frac{1}{7}$ respectively; hence their thermal separations should be the same if the force fields are identical, and again this provides a delicate test of this identity; since in this case one mixture of each pair has no rare radioactive constituent, the thermal separation can be determined for a variety of concentration ratios, and an estimate made of the limiting value of k_T for a small concentration ratio of the heavier constituent (corresponding to the concentration of the radioactive constituent in the other mixture of the pair).

If these tests bear out the identity of the fields of force between different isotopic molecules, the interpretation of thermal separation data for other isotopic pairs is simplified, but in any event a complete set of such data, for these nine mixtures, in which the proportionate mass-difference m ranges from 0 to $\frac{3}{7}$, can be used to determine three constants[18], A, B, C, which appear in the formula for k_T, and which depend on the law of force at collisions between the *unlike* molecules of each mixture. If the force-law is $f(r) \propto r^{-n}$, these three constants are all known functions of n, and n can be inferred from any one of the three constants; if it were found that A, B, C do not all correspond in this way to one value of n, it would be proved that the force law is not of this simple form, and an indication would be gained as to how $f(r)$ diverges from this simple law.

The interpretation of such thermal separation data may require some extensions of the theoretical formula for k_T, offering no great difficulty. The combination of such theoretical and experimental work should lead to much more precise empirical knowledge of the field of force of hydrogen molecules than we now possess, and would be of value in testing further fundamental theoretical work on the hydrogen molecule.

Similar experimental studies might be made also on numerous isotopic mixtures for many other chemically elementary or compound gases, and would lead to a useful extension and a much increased precision in our knowledge of their fields of force.

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SCREENED DUST AND ITS USES

By William B. Strain,
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THERE is an old saying in agricultural circles in Scotland that you only take out of the soil what you have put in. To a greater or lesser degree this is correct, having regard to the elements necessary for supporting and maintaining the germination and growth of each particular plant.

Many factors contribute to the growth of a plant and most plants have their idiosyncrasies, as conversely there exist ideal conditions peculiar to the natural growth of particular plant life. Thus we have some districts of the country where potatoes grow best, others are better for carrots, beetroot, hay, oats, hops, and so forth. It therefore follows that in dealing with the fertilizer and its effects on plant life we must take into account the chemical and bacteriological condition of the soil, its physical characteristics, climatic conditions, etc. Nevertheless there are certain factors which must be present in all cases of plant cultivation, and of these, certain chemical elements are essential to plant growth.

When considering the use of screened dust therefore as a means of increasing soil fertility, we do not claim that it will grow any kind of plant, but at this particular time, when there is a need of fertilizers, screened dust forms a very useful, cheap and abundant means of conserving the better-known manufactured fertilizers specially suited to specific plants.

Conservation of Fertilizers

There is almost certain to be a shortage of imported fertilizers, and many manufacturers are searching around for some means of augmenting the anticipated shortage. Next year's crops must be raised and fed. Greater crops than ever must be grown by our own efforts. We cannot afford to risk importing either the fertilizer or foodstuff if the wherewithal to produce or grow them is already in our hands.

In almost every industry, business concern, farm and household throughout the length and breadth of the country we have in the past twenty years attained a sense of squandermania which is nothing short of sinful. Easily handled bags of fertilizers arrive on the farm which has been robbed of its organic requirements all these years. Many of the constituents of this fertilizer have been imported from foreign lands, thousands of miles distant ; yet lying to hand, we have permitted city, town and country to dissipate organic matter and chemical elements amounting to millions of tons per annum. What then is the answer to waste ? It comprises one simple word—utilization. Everything must now be utilized and returned as raw or basic material to the particular industry requiring it. Manures or fertilizers are available in Great Britain in our so-called waste materials to the extent of hundreds of thousands of tons.

We must forget the economic aspect where the production of our food is concerned, as a sufficient quantity of food to meet war-time needs cannot be grown unless manures and fertilizers are produced from previously untapped sources within the confines of our own borders. Everything of manurial value should be utilized, and the following are a few sources with which I have experimented : (1) Sea wrack or sea-weed. Hundreds of thousands of tons of this valuable material go to waste annually. (2) Leaves from trees. There must be vast quantities of this material in the woods and forests of Great Britain. In my own town, forty tons were collected from the streets last autumn and the tonnage was only representative of trees overhanging public roadways. (3) Garden refuse. If separated into two classes (*a*) hard, and (*b*) soft, the former can be burned and valuable potash secured whilst the latter can be made into an excellent organic compound. (4) Damaged fruit. (5) Fish waste. (6) Night soil or sewage mixed with screened dust or other binding material. (7) Slaughter-house offals. (8) Existing refuse coups or tips where the household refuse has been disposed of for many years to an almost unbelievable extent. (9) Screened dust.

From these nine sources alone, hundreds of thousands of tons of valuable material can be obtained and rendered suitable for growing our foodstuffs either by one of the many manufacturing processes already existing or by the aid of Nature herself. A great deal of study and progress

has been made in the past few years and the authorities concerned could easily be brought together to organize the collection, treatment, and disposal to agriculture of these so-called waste materials which are lying dormant. To illustrate what can be done with so-called waste material, I undertook research work in collaboration with the Hannah Dairy Research Institute, Ayr, on the subject of a very lowly material now well known as screened dust. This material consists of the very fine riddlings of household refuse which will pass a 5/16 riddle.

For many years it had been used for opening up heavy clay soils or mixed as a binder with slaughter-house offals in many parts of the country, but there was a lack of information obtained under the control or direction of competent authorities. The experiments were therefore undertaken to discover the true value of the material, and a fascinating period of study revealed that the grey dusty material had many very interesting characteristics peculiar to it.

To begin with, it was discovered that screened dust is comprised almost entirely of fine ash from household coal, which is only partly burned out because of the lamentable inefficiency of the everyday household fire. It therefore retains a good number of the qualities of coal itself.

Source of Supply

Screened dust is obtained from the household refuse and has to be riddled through a 5/16 and ¼ in. screen to obtain it free from glass. The refuse should also be passed over a small magnetic separator so as to eliminate the possibility of foreign matter such as pins, nails, razor blades, etc. The household fire is therefore the homely source from which we receive screened dust among the household ashes. It is very finely divided, for the greater part less than ¼ in., and much of it is a very fine powder of particle size. It can be mechanically riddled to a fine consistency of good appearance.

Application to Farmlands

Applications of five tons per acre or slightly more give excellent results on sandy soils, loams, clay loams, heavy clay, and even poor sandy soil, and particularly on land which has a tendency to acidity. The material is usually broadcast by a shovel from a cart; but some farmers now desire to spread screened dust by a manure-sowing machine. An alternative method is the use of a road gritting machine.

The material acts both mechanically and chemically on soil—opening up heavy land, allowing aeration and supplying food to the plant.

Crops which will Benefit from Screened Dust

Timothy, rye grass, cocksfoot, backward clovers and mixed hay crops are improved by the use of screened dust. The straw or stem is of a much harder and better keeping quality than similar crops manured with farmyard manure. In some cases timothy hay has been observed to grow twice to three times more hay than with the normal dressings. Where seeding of timothy and rye grass hays have taken place, the seeds have been well filled and much heavier by weight than in other or the same fields on the farms concerned which had been manured by other means.

Pasture land and clover respond well to screened dust. Oat crops treated with screened dust withstand heavy weather much better if in an exposed position. Some excellent crops have been grown in this way. Turnips, cabbage, mangold, potatoes, lettuce and like crops grow well when screened dust is applied to the soil. Last year's experiments with mangold showed that the seeds sown in screened dust itself, laid to a depth of five feet with no soil present, saw a good crop of mangold through all the stages of growth. Thus it was proved that screened dust itself has all the properties present to propagate and support plant life without assistance of any other soil or fertilizer. This can be safely vouched for, as evidenced by the very vigorous growth of all kinds of plants in a field near Ayr which is covered to a depth of one foot with screened dust.

Temperature Increase of Screened Dust

A considerable increase of temperature takes place when screened dust is laid in a heap of three feet deep. The temperature over a period of four to six days after screening may attain 150° F. to 160° F. Thus a certain degree of sterility can be assured if the dust is allowed to lie in heaps for six days after being screened.

Presence of Organic Matter

The percentage of organic matter present in screened dust is surprisingly high and varies between 13 and 35 per cent, and if the recommended dressing of five tons per acre is adhered to, a liberal amount of organic matter will be applied, much of which seems readily available for plant food.

Trace Elements

An examination of screened dust was undertaken by the Macaulay Institute, Aberdeen, to which I am indebted for the information contained in Table 2.

The importance of the trace or minor elements in agriculture has been stressed during the past few years both in Great Britain and abroad. In any manurial treatment of soil for crops it is essential that, together with the application of such well-known fertilizers as the nitrogenous, phosphatic, potassic and lime varieties, attention must be paid to any possible minor element deficiency, otherwise unsatisfactory crops may be obtained. Such crops may be unsaleable, give an uneconomic return, or have a serious effect on animals fed with them.

Of the minor elements perhaps most importance has been laid on boron, iron and cobalt. It seems evident from well-controlled experiments that the disease of turnips, known as 'raan', can be eradicated by the application of dressings of small amounts of boron to the soil. Further, in cases where raan was not found to any large extent, an increase in the total weight of turnips per acre was noted. Similarly, with sugar beet, the yield was markedly improved and the incidence of heart rot was considerably lowered when boron compounds were applied before sowing the seed. With cobalt the effect of a deficiency is not apparent in the plants, but becomes evident when these are fed to animals.

In Australia and New Zealand certain sheep diseases, which eventually result in the death of the animals, have been shown to be due to a deficiency of cobalt in the soil and plants. More recently in Great Britain a cobalt deficiency disease of live-stock has been discovered, a disease which can be effectively eradicated by the application of cobalt salts to the pasture on which the animals graze. Similarly with every one of the minor elements, we find that at least a trace is essential for the production of good land, sound, healthy crops, and healthy live-stock. As will be seen from Table 2, screened dust supplies all the known important minor elements in considerable quantity and the others in smaller amounts. Screened dust, therefore, is about the only fertilizer in use to-day which supplies all these elements in one dressing.

For the removal of decayed grass known as fog or the elimination of moss on lawns, screened dust is of great assistance. Good results have been obtained in kitchen gardens, potting and carnation growing. Many more fields of exploration are open, such as application to golf courses presently being used for grazing sheep and so forth. Amateurs and professionals alike can profitably experiment with the ash, direct from the household fires and passed through a ¼ in. riddle.

For potting or framework, one part screened dust to six parts soil can be recommended for opening up a stiff soil.

Table 1. Analysis of Dust.

Sample No.	Nitrogen	Water	Organic matter	Ash	Analysis of ash expressed as percentage of total sample				
					SiO_2	$Fe_2O_3+Al_2O_3$	CaO	P_2O_5	Sulphur
A	0·374	18·9	20·1	61·0	32·7	11·7	6·58	0·28	2·09
B	0·434	9·8	17·7	72·5	39·7	9·2	10·66	0·27	2·02
C	0·428	8·4	18·8	72·8	38·5	9·3	9·05	0·27	2·02
D	0·419	16·2	24·8	59·0	37·6	9·4	7·79	0·18	0·86

Table 2. Trace Elements. Spectrographic Examination of Sample of Refuse Dust.

Present in quantity	Present in small quantity	Present in large trace	Present as trace	Present as slight trace	Not observed
Silicon	Manganese	Boron	Germanium	Arsenic	Cadmium
Aluminium	Vanadium	Lead	Tin	Rubidium	Mercury
Iron	Potassium	Copper	Molybdenum	Caesium	Gold
Carbon		Zirconium	Silver	Zinc	Ytterbium
Phosphorus		Beryllium	Chromium		Antimony
Titanium		Cobalt	Gallium		Bismuth
Calcium		Nickel			Indium
Magnesium		Barium			Thallium
Sodium		Strontium			Scandium
		Lithium			

OBITUARIES

Dr. C. H. Merz

OUR deepest sympathy goes out to Mrs. Merz on the tragic death of her husband, Dr. C. H. Merz, and their son and daughter who were victims of recent enemy action; a maid and chauffeur, who had been their devoted servants and loyal friends, died also in this attack.

Charles Hesterman Merz was born at Gateshead-on-Tyne in 1874. He was the son of the late Dr. J. Theodore Merz, the learned author of the "History of European Thought in the Nineteenth Century". His mother was Alice Mary, daughter of Mr. Edward Richardson, of Newcastle-on-Tyne, who belonged to a well-known Quaker family. He was educated at Bootham, York, and received his technical training at Armstrong College. Electric power and railway traction schemes all over the world bear witness to his work. In 1898, after training and experience at Newcastle, Lincoln, London, in Ireland and other places, Merz acted as engineer for the promotion of a Bill for supplying electric power to works and shipyards on Tyneside. This was the first of the 'power bills'. Afterwards he acted as engineer for the first company to use three-phase distribution in England at the then high pressure of 6,000 volts. In 1900 the company amalgamated with the Newcastle-upon-Tyne Electric Supply Company, and the combined undertaking (now the North Eastern Electric Supply Co., Ltd.) expanded during the succeeding eight years, until it covered Northumberland and Durham and parts of Yorkshire. This involved the first large-scale use of 20,000-volt underground cables, and the first extensive use of high-voltage overhead lines in Great Britain. Neptune Bank Power Station, which Merz designed, was commissioned in 1900, and was the first to use large Parsons turbo-alternators. About this time Merz took into partnership William McLellan, who had been associated with him in all his work at Tyneside; this partnership continued until McLellan's death in 1934.

In 1907 Merz visited Australia to advise the Victorian Government on the introduction of electric traction. He laid down the basis of the legislation and organization adopted for the control of the power industry in Victoria. In 1909 he visited the Argentine and reported on the adoption of electric traction in the neighbourhood of Buenos Aires. In 1913 he visited India on the invitation of the Government of Bombay and reported on the electrification of the suburban railways. He was retained in an advisory capacity by the Commonwealth Edison Co. of Chicago, and was responsible for large railway electrification schemes, including the conversion of the South African railways and the Great Indian Peninsular Railway. He compiled the technical report for the Weir Committee which investigated the question of main line electrification in Great Britain.

During the War of 1914–18, Dr. Merz was director of Experiment and Research to the Admiralty, and within the same period served on the Haldane and Williamson Committees, which recommended the appointment of the Electricity Commissioners. In 1925 Merz put before these Commissioners a memorandum which resulted in the appointment of the Weir Committee, the report of which led to the Act of 1926 setting up the Central Electricity Board and to the construction of the Grid. At Sir Andrew Duncan's request, Dr. Merz was to have placed gratuitously his great and varied experience at the service of the Ministry of Supply from October 28 of this year.

In 1913, Merz married Stella A. P. Byrne, daughter of Mr. Edmund de Satur, of Dublin, and had one son and one daughter. He was a vice-president of the Institution of Electrical Engineers during 1912–15, and was awarded the Faraday Medal in 1931. In 1932 he received an honorary D.Sc. from the University of Durham. He was a member of the Institution of Civil Engineers and various other technical societies and was also a fellow of the American Institute of Electrical Engineers. All who knew him feel that one of Britain's great men has been taken from us, and those who knew him best feel it most.

ALEXANDER RUSSELL.

Dr. M. Mathisson

THE death of Dr. Myron Mathisson on September 13 at the early age of forty-three has cut short an interesting line of research. Mathisson had been engaged for many years in studying the general dynamical laws governing the motion of a particle, with possibly a spin or a moment, in a gravitational or electromagnetic field, and had developed a powerful method of his own for passing from field equations to particle equations. The subject is of particular interest at the present time, as it has now become clear that quantum mechanics cannot solve the difficulties that arise in connexion with the interaction of point particles with fields, and a deeper classical analysis of the problem is needed. It is much to be regretted that Mathisson's death has occurred before the relations between his method and those of other workers on the subject have been completely elucidated.

Mathisson carried out his work at the Universities of Warsaw and Kazan and at an institute which he started in Cracow, and, since the spring of 1939, at Cambridge.

P. A. M. DIRAC.

WE regret to announce the following deaths:

The Rev. W. G. Ivens, an authority on Melanesian languages.

Sir Herbert Wright, treasurer of the Imperial College of Science and Technology, an authority on tropical agriculture, especially rubber, on October 28, aged sixty-six.

NEWS AND VIEWS

Mr. Franklin D. Roosevelt

THE election of Mr. Roosevelt as President of the United States for a third term of office, though by no means unexpected, will be accepted by onlookers as the strongest endorsement of the policy he has followed in the present world conflict. Not only has he consistently pledged the American people to full support of the Allied cause in the interest of the democratic ideal, but also he has secured that practical effect should be given to that pledge by bringing the vast material resources and industrial power of his country to bear upon the problem of supplying the needs of the Allies for the munitions of war, so far as compatible with the requirements of America itself for purposes of defence. It cannot be doubted that in casting their vote for Mr. Roosevelt, notwithstanding that no president hitherto has served more than two terms of office, the American people have been profoundly affected by their appreciation of the necessity of placing beyond question continuity of policy in the assistance afforded the Allies. On one hand, the President's reiteration that America's effort shall be the maximum, short of war, secures, as Mr. Joseph Kennedy has pointed out, that supplies shall suffer no diminution through arming American forces on a basis other than for purposes of defence. On the other hand, Mr. Roosevelt has so framed his policy and that of the political party of which he is the leader and the representative as to secure, both now and possibly even more in the future, a maximum of co-operation between the democratic peoples of the Americas outside the United States with those who are now engaged in a life and death struggle for the continued existence of democracy in the Old World.

German Culture in Czechoslovakia

THE Czechoslovak National Council has just issued a publication, "German Cultural Oppression in Czechoslovakia" (London: Allen and Unwin, 6*d*.), outlining the position in the protectorate of Bohemia and Moravia. Oppressive measures began after the Munich "agreement" of 1938, whereby a million Czechs in the ceded territories lost their scientific and technical institutions and places of higher education and culture. Pressure was simultaneously brought to bear upon the still nominally independent Czech Ministry of Education to eradicate Jewish and other "undesirable" elements in the universities. After the German entry into Prague in March 1939, all cultural work and scientific research came to a standstill. All Government departments and local administration passed into German hands and since that time the *furor teutonicus* has raged against all the intellectual activities of the nation. A Nazi censorship spent months purging libraries of every book or journal containing any reference distasteful to its narrow doctrines. Concurrently with this, books and valuable apparatus were removed from Czech universities, scientific institutes and museums and were either sent to Germany or wantonly destroyed.

These activities were followed by the massacre of Prague students in November 1939, an act attributed to the students' own disturbances, which "necessitated" the closing of all Czech universities, medical schools and establishments of higher education. It is established that a hundred and fifty students were executed, whilst the total deaths (including university lecturers and secondary schoolmasters) amounted to more than a thousand. In addition, no fewer than seventy thousand intellectuals, students, authors, etc., were imprisoned or sent to German concentration camps. Those who escaped arrest have been persecuted in other ways. All contact with the rest of the world was prohibited, and at best these savants have lost their means of livelihood through the closing of the universities. These activities form but a small part of the systematic Nazi oppression in countries now under German rule, but they cannot be passed over in silence. Men of science and learning throughout the world will condemn heartily such conduct towards a courageous people whose high intellectual standard may be inferred from the fact that theirs is the lowest percentage of illiterates in the world.

Egyptian Bird Observations

THE extension of the theatre of war for the winter campaign in Egypt with the presence of a large Allied Army in the Nile valley affords much opportunity for ornithologists on active service in all ranks in the Near East, and recalls the numerous and important field observations on British birds and migrants in Egypt made by Army men during the War of 1914–18. Since von Heuglin surveyed Egyptian bird-life in his epic work on north-east Africa, and Shelley produced his book on Egyptian birds, Colonel Meinertzhagen in 1930 produced under the authority of the Egyptian Government a two-volume collection of Nicolls' records of birds of Egypt. The Giza Zoological Gardens where Nicolls worked and collected are still visited by waterfowl like the shoveller. Demoiselle and great cranes gather by the thousands on the banks of the Nile. Jack snipe from northern Europe are winter visitors, while great egrets, wood ibis, sandpipers and numerous ducks and waders complete the bird-life of the Nile valley. Curlew, redshank, grey plover, dunlin, spur-winged plover, shoveller, mallard, teal, pied kingfishers, kestrels and marsh-harriers are among the bird-life of the royal estate at Dahshur.

In winter and early spring, huge congregations of birds are always to be seen beside the White Nile and south of Khartoum. White- and blue-headed wagtails are very numerous, along with wheatears, shrikes, pipits and a wealth of raptorial birds such as peregrines, red-footed falcons, hobbies, Montague's harrier,

etc., and of waders like godwits, stilts, green-, wood- and curlew-sandpipers, Kentish plovers and of duck such as pintail, garganeys and a few widgeon. There are common, purple, squacco and night herons, spoonbills, storks, glossy ibises, singly or in great flocks, trips of ruffs by the water, swallows, house-martins, sand-martins and swifts over the water. Most of these birds may be seen passing through Egypt by the Nile or down the Suez Canal, where the Kentish plover nests on the marshes. In north Egypt in winter may be seen such British birds as song thrushes, robins, blackbirds, starlings, skylarks and lapwings in some numbers.

Earthquakes in Rumania and Turkey

On October 22 earthquakes shook many districts in Rumania and Turkey. Earthquake tremors of medium intensity were registered in Bessarabia, Kieff, Kharkoff and elsewhere in the Ukraine, apparently coming both from the Carpathians and the Caucasus. On the same morning about 8.30 a.m. (local time) a severe shock was felt at Barlag close to Basau near the Carpathians, where children were injured and one boy killed when the roof of a school collapsed. Many other houses were damaged, and some people were unable to stand at the time in the streets. In Bucharest the shock is said to have been the most severe for many years. It is reported to have been a double shock, of total duration according to human perception of about thirty seconds, and to have caused considerable cracks in several stucco buildings besides breaking windows and shaking movable objects (modified Mercalli scale VII). No one was injured in the capital.

Apparently about the same time as the Rumanian shocks the Turkish port of Smyrna was rocked by a severe earthquake, though no serious damage or casualties have been reported. It appears unlikely that the shakings in Rumania and Turkey were due to the same earthquake as surface waves of moderate intensity are soon damped out. Further information from the seismological observatories is awaited before the exact times and epicentres of the shocks can be worked out. Earthquakes in all these regions are not uncommon. Prior to being affected by the great Anatolian earthquake of December 26, 1939, Smyrna was seriously damaged by earthquakes on March 31, 1928, and on September 20, 1899.

Electrical Engineers and the War

In his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. R. Beard, of Messrs. Merz and McLellan, gave first a short account of the war-time activities of electrical engineers, and then made many thoughtful comments on the planning of the post-War world. He said that in this War, engineering, technological and scientific problems are playing a greater part than ever before, and that the many branches of electrical engineering have all been directly or indirectly engaged in war activities. The Institution of Electrical Engineers has now the largest membership of any British professional institution. During the past year, the membership has exceeded 20,000 and its responsibilities are correspondingly great. He mentioned particularly the strenuous work undertaken by those engaged in the light current branches. These include such vital services as communications and broadcasting, and the design and manufacture of the apparatus for them and of the similar apparatus for the rapidly expanding needs of the Royal Navy, the Army and the Royal Air Force. In particular, those engaged upon research and development in the multifarious new applications of wireless deserve special record.

Some 1,285 members of the Institution are on active service with His Majesty's Forces, but, unlike the position in the War of 1914–18, almost all of these are engaged in a technical capacity which makes use of their specialized knowledge. The bitter experience of 1914–18, when so much technical talent was wasted through trained men being drafted from productive work into non-technical units, was fortunately taken to heart in good time. Some time before the War broke out, the Ministry of Labour organized the schedule of reserved occupations. On the whole, this has functioned admirably. The Institution has always taken pride in the number of its overseas members, which now amounts to one fifth of the total membership. For many years there have been local centres in the Argentine and China, and there are sixteen local honorary secretaries and twelve overseas committees in many parts of the world. These are an invaluable liaison between distant members and headquarters. Much attention has been given to increasing these contacts with the engineering institutions in the Dominions and India. At a time when the joint defence of our liberties in face of the assault on all free peoples is forging still closer the links of the British Commonwealth of Nations—and indeed of all English-speaking peoples—Mr. Beard reminded members of the Institution overseas that their share in the war-time activities of our various countries is in no way less important than the work of members at home, and that this is recognized and appreciated. Plans for yet closer collaboration after the War are eagerly anticipated.

Early Harbour Engineering

In his presidential address to the Institution of Civil Engineers delivered on November 5, Sir Leopold Saville said that since the branch of engineering with which he had been principally associated was harbour engineering, he proposed to deal with harbours from the dawn of written history to the early days of the Roman Empire. He reviewed first the development of the four harbours of Alexandria, namely that of A-ur, about 3000 B.C.; the great harbour of Pharos, soon after 2000 B.C.; the harbour of Alexander the Great, begun in 332 B.C.; and the modern harbour, A.D. 1870. He then turned to the pre-Hellenic harbours of Tyre. By 1400 B.C. the renown of the city was widespread, and by 1100 B.C. its seamen had passed Gibraltar and had dared the Atlantic. It was probably about that time the Sidonian harbour was built; Hiram, king of Tyre (970–936 B.C.), built the

Egyptian harbour. In Greece, deep bays and long arms of the sea made excellent natural harbours; moreover, Greece was divided into many small States, each with its own port. Athens used first the broad open bay of Phalerum, where ships were beached in sight of the city. That arrangement, however, had several strategical and navigational disadvantages, and in 493 B.C. Themistocles persuaded the Athenians to develop the fine natural harbour of Piræus. At some places artificial harbours had to be constructed, of which that at Eleusis was typical.

The Romans had to face difficult technical problems when their growing commerce demanded effectual shelter. They introduced many new methods, the most outstanding of which were the use of the arch, the cofferdam, hydraulic cement (pozzuolana), and the driving of piles in deep water. The Roman ideal plan was an artificial harbour having the two incurving breakwaters of the Greeks, with the Roman addition of a short protecting mole or island breakwater in front of the entrance. The sand problem caused considerable trouble, and silting drove the Romans from Antium and the Tiber and caused the failure of the harbour of Ostia. Trajan accordingly took measures to provide a new harbour for Rome higher up the coast, which under its modern name of Civita Vecchia is now the principal port of Rome. The Roman Empire was followed by more than 1,000 years of acquiescence, or even retrograde action, in harbour engineering, and it was not until the engineering revival in about the middle of the eighteenth century that such ambitious schemes were again attempted.

Electric Fan Ventilation

The necessity for air-raid precautions and for black-outs has introduced several problems besides that of lighting which have to be studied. In the *Electrician* of October 11 a discussion is given of some important considerations with respect to electric fan ventilation. One attendant result of most of the measures taken for black-out and sandbagging against the effect of bombing is the restriction of the natural air-flow and an increase in the heat dissipation due to augmented lighting. Since it is known that a relatively high proportion of carbon dioxide can be permitted without any ill-effects, in big ventilation systems a large percentage of the air is recirculated in order to conserve the heat. Hence where the volume of air relative to the number of persons concerned is large, an air disturber serves a useful purpose in both summer and winter. In smaller places the most usual method of ventilation under ordinary peace conditions is by exhaust, but it is now common to take into consideration the presence of gas from enemy action, and for such eventualities it is necessary to take in a supply of clean air by means of an intake placed so as to be above the level likely to be contaminated. Complete protection is afforded by first passing the air through a filter.

The number of air changes required in various public buildings is laid down by law, but for offices, shops, factories, etc., the figure depends on the work to be carried out and the types of processes involved. For the average type of office, two to three air changes an hour will be sufficient, for dining-rooms four to six, but for kitchens fifteen to twenty changes may be necessary. Where long runs of ducts are necessary for extracting from a number of rooms, the resistance of the air in the ducts may be more than a propeller fan can deal with, and a centrifugal fan should be used.

Primitive Trepanning

The surgical operation of removing a circular piece of bone from the human skull of the living is one which it has long been known was practised by primitive man with, relatively speaking, some frequency. The practice had a wide distribution in both time and space, ranging chronologically from the early neolithic period to modern times and geographically from many parts of prehistoric Europe (and in historical times in Serbia) to the Pacific. Late prehistoric or early historic examples are known from the Caucasus, Palestine and Siberia, while the practice was frequent in pre-Inca and Inca Peru and Bolivia. In the last-named region, however, there is a possibility that there has sometimes been confusion with a syphilitic lesion. The frequency of a depressed fracture in a stone age culture using the stone axe as a favourite weapon must, obviously, be held responsible for the introduction of the operation; but there is evidence that it was also employed for the alleviation of any violent pain in the head. A variant practised for the relief of headache in New Guinea is drilling with a boco-drill and flint fleam. The appearance of amulets made of circular pieces of bone taken from a trepanned skull, which are among prehistoric finds, points to the infiltration of magical ideas—never long unobserved in primitive methods of healing—and affords an explanation in part for the performance of the operation at or after death.

The uniformity in the technique of the operation, the cutting of a circular groove with a stone implement, or rarely a series of drill holes, or grooved straight lines forming a rectangle—suggests the possibility of its distribution by cultural diffusion. Mr. Stuart Piggott, however, in a study of the practice in prehistoric Europe, to which reference is made on p. 621, holds the view that in its earliest appearances when it is a remedial measure for individual injury it is to be regarded as an independent invention, but that when it becomes a cult —a justifiable reference from the evidence—we are justified in looking for links between instances in which the rite was practised. Working from the early centre of greatest frequency in the Lozère valley of southern France and ingeniously associating the rite of trepanation with megalithic building and the cult of the megalithic goddess, he traces it to the mouth of the Garonne along the line of the Bronze Age trade route along the oolite and to the Paris basin, whence it spread with the SOM culture characteristic of that area in this period.

Primitive Irrigation in South-Western U.S.A.

The south-western regions of the United States of late years have won a prominent place in archæological news as a source of evidence of earliest man, the hunter, on the American continent. It had been known for some considerable time, however, that the arid lands of Utah, Colorado, Arizona and New Mexico were the seat of the so-called Pueblo civilization, which had produced not only the remarkable cliff dwellings found in the Pueblo villages, but also that these villages are among the oldest known agricultural settlements in the United States. There sedentary farmers practised a specialized form of agriculture with maize as its main crop. Notwithstanding the varied topography of these arid regions, the farmers had a common interest and preoccupation —the problem of irrigation. So successful were their methods that, in 1540, when Coronado reached Hawikuh, the most southerly of the "Seven Cities of Cibolu", the villages were able to supply him with sufficient corn to support his three hundred and twenty men and their native carriers for a period of two years.

At this early date, the mode of life and agricultural system had been so long established that not only had early sites of settlement been abandoned on a large scale, but also one of the most important groups of Pueblo villages, that of Mesa Verde Plateau, discovered in 1888 and now a national park, had been given up so long before the coming of the Spaniards that it receives no mention in any of their narratives. The overwhelming importance of rainfall in the life and thought of the early Pueblo peoples may be gauged from the ritual and methods of present-day Hopi and Zuñi tribes, which preserve the tradition, probably with little change, while evidence of the elaborate and skilfully devised irrigation system is still available on the ground as material for a reconstruction (see NATURE of November 2, p. 591).

Cancer in an Oil Refinery

The issue of *Public Health Reports* for August 23 contains an interesting paper by William M. Gafafer, senior statistician, and Rosedith Sitgreaves, of the United States Public Health Service, on disabling morbidity and mortality among the male employees of an oil refining company with reference to age, sex and duration from 1933 to 1938 inclusive. During this period a total of approximately 60,000 years of membership for male employees yielded 70 cases of cancer of which 46 were fatal. These cases included five which began in 1932 and ended in 1933, but excluded four which began in 1938 and were carried over into 1939. The cases which did not end in death terminated in recovery or sufficient improvement to return to work. The employees of the oil refinery showed relatively more cancer of the digestive tract than occurred among the total population, while the proportion of cancer of the genito-urinary tract was much less. The two sites—stomach and other abdominal organs—accounted for more than half the cases, and each specific site showed increases with age with respect to both frequency and mortality. For all ages the ratio of cases to deaths was less than 1·2 in three sites, namely, the œsophagus, stomach and other abdominal organs. Cancer of the lung showed the largest average case duration as well as the largest average duration of non-fatal cases.

Vitamin B_1 in Bread

The Minister of Food has appointed the following committee, which includes representatives of the flour milling industry and the baking trade, for consultation with the Ministry on the administrative and technical questions associated with the introduction of synthetic vitamin B_1 and calcium into white flour: Mr. H. D. Vigor (chairman), Mr. Edmund B. Bennion, Mr. W. Bloor, Prof. E. C. Dodds, Mr. T. H. Hodgson, Prof. R. A. Peters, Mr. J. Arthur Rank, Mr. Arthur Robinson and Dr. J. Sword.

Announcements

Prof. D. L. Savory, professor of French and Romance philology, was returned unopposed in Belfast on November 2 as Unionist member for Queen's University in the British House of Commons in succession to Colonel Thomas Sinclair, who resigned after holding the seat since 1923.

Ministry of Transport returns show that 578 persons were killed in road accidents last July as compared with 554 in July 1939. Only 115 of these deaths occurred during the black-out hours, and adult pedestrians and cyclists were mostly affected, 132 and 107 deaths respectively being registered in these groups.

At the annual statutory meeting of the Royal Society of Edinburgh held on October 28, the following officers were elected: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Dr. Leonard Dobbin, Mr. J. A. Inglis, Prof. R. Stockman, Prof. James Ritchie, Dr. G. W. Tyrrell and Prof. C. T. R. Wilson; *General Secretary*, Prof. James P. Kendall; *Secretaries to the Ordinary Meetings*, Prof. R. J. D. Graham and Prof. W. M. H. Greaves; *Treasurer*, Dr. E. M. Wedderburn; *Curator of the Library and Museum*, Dr. J. E. Mackenzie.

The Council of the University of Leeds, on the recommendation of the Brotherton Collection Committee, has gratefully accepted a bequest by the late vice-chancellor, Sir James Baillie, of his private note-books consisting of twelve volumes of philosophical reflections written during 1894–1937 and entitled "Privatissima", together with other unpublished manuscripts, printed papers and a rare photograph of Hegel. In accordance with Sir James Baillie's expressed wish, the papers will be deposited and kept in the Brotherton Collection Rooms, and no part of the contents of the "Privatissima" will be published within ten years from the time when they came into the possession of the University.

In the paragraph headed "Trephining in Great Britain" in NATURE of September 28, p. 433, the reference to a paper on trephining in New Britain is incorrect; the correct reference is "Rev. J. A. Crump and V. Horsley, *J. Anthrop. Inst.*, **31**; 1901".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Terminology of Relative Growth-Rates

FOR many years past, biologists have been interested in the rates of growth of parts of organisms in relation to the whole or to other parts. Such ratios were termed by Huxley[1] *constant differential growth-ratios*, and the whole process by Pezard[2] *heterogony*. The process may obviously be either positive, if the relative size of the part increases with time (that is, grows more rapidly than the whole), or negative, if the relative size diminishes (that is, grows more slowly). If it attains an extreme degree, it might be called, in Champy's phrase[3], *dysharmonic growth*. Some authors, for example, Teissier[4] (who, with Needham[5], introduced the application of these concepts to the chemical constitution of the body) at first adopted this usage; but it has not proved acceptable, since, if we liken the organism to a piece of music, the growth of all parts at the same rate would be unison, and their growth at different rates harmony, not disharmony. Later, after the term *heterogony* had come into very general use, Huxley and Teissier[6] proposed its replacement by *allometry* on the ground that heterogony had previously for a long time been employed by sex physiologists to denote a special type of reproductive cycle.

The term allometry was considered by Huxley and Teissier to be advantageous in that it could be applied both to phenomena of growth and to phenomena of proportionate size. Since terminology, which does not distinguish between differences during growth, at any given stage of growth, or after its completion, is bound to lead to ambiguous interpretation in many instances, the advantages of an all-embracing term are doubtful. Furthermore, *heterogony* after all implied something inherent in the developmental plan of the organism, while *allometry* seems to refer only to our metrical methods. Hence we welcome a suggestion to one of us (J. N.) by Dr. Arthur L. Peck, of Christ's College, Cambridge, that for relative *growth*, in contradistinction to relative *proportions*, the word *heterauxesis* should be used, with *isauxesis*, *bradyauxesis*, and *tachyauxesis*, for the three cases formerly known as isogony and negative or positive heterogony. It is true that the terms auxesis, heterauxesis, ectauxesis, endauxesis, etc., were formerly employed in plant physiology[7], but they have long been obsolete there. On the other hand, botanists do still distinguish between *auxesis* or growth by expansion, and *merisis* or growth by cell-multiplication, a usage which enhances the suitability of the term heterauxesis for all dimensional and chemical differentiation.

Comparisons may be made between organisms of the same group differing in age, size, weight, chemical composition, etc.; this is *heterauxesis*. But comparisons may also be made between organisms of different groups (races, varieties, species, genera, and the like) differing in size or other qualities but of the same age, for example, birth or adult maturity. We suggest that the word *allometry* and its attendant *isometry* should be reserved in future for this. In many such cases the Huxley equation holds good; for example, the relation between egg-size and bird-weight (in his book[1]), or the work of Hersh[8] on titanotheres, or Lumer on skeletons of dog races[9], or that of one of us (I. M. L.) on gluathione in different races of rabbits at birth (Lerner, Gregory and Goss[10]). The word *allometry* has been used in a similar sense by Osborn[11], who thus described evolutionary changes in bodily proportions. The co-ordinate distortions of d'Arcy Thompson[12] would thus be said to represent allometric differences. The exponent in the allometric relations may be called the *limiting equilibrium constant* or *ratio* in accordance with the suggestion of Huxley and Teissier[6]. In the case of heterauxesis *actual equilibrium constant* or *growth-ratio* may be used. Similarly, *enantiometry* should be distinguished from *enantiauxesis*.

We venture to hope that these suggestions will be widely approved, and would propose that the distinctive usage of these terms be in future generally adopted. Such a practice would eliminate confusions which undoubtedly occur at present between the two types of comparison.

JOSEPH NEEDHAM.
University of Cambridge.

I. MICHAEL LERNER.
University of California,
Berkeley, California.
Sept. 2.

[1] Huxley, J. S., "Problems of Relative Growth" (London, 1932).
[2] Pezard, A., *Bull. Biol. Fr. and Belg.*, **52**, 1 (1918).
[3] Champy, C., "Sexualité et Hormones" (Paris, 1924).
[4] Teissier, G., *Trav. Stat. Biol. Roscoff* **9**, 27 (1931).
[5] Needham, J., *Biol. Rev.*, **8**, 180 (1933).
[6] Huxley, J. S., and Teissier, G., NATURE, **137**, 780 (1936).
[7] Roux, W., Correns, C., Fischel, A., and Küster, E., "Terminologie der Entwicklungsmechanik" (Leipzig, 1912).
[8] Hersh, A. H., *Amer. Nat.*, **68**, 537 (1934).
[9] Lumer, H., *Amer. Nat.*, **74**, 439 (1940).
[10] Lerner, I. M., Gregory, P. W., and Goss, H., *Proc. Soc. Exp. Biol. and Med.*, **35**, 283 (1936).
[11] Osborn, H. F., *Amer. Nat.*, **66**, 52 (1932.
[12] Thompson, d'Arcy, "Growth and Form" (Cambridge, 1917).

Attraction Fields *in Vitro*

In unpublished researches of Fardon, Sullivan and Andrus[1], a series of experiments were conducted showing the outgrowth of cells from traumatized sections of embryonic chicken intestine *in vitro*. It was observed at the time that the new outgrowth of cells aligned itself into uniform patterns. The nature of the outgrowth was analogous to the fields surrounding a bar magnet. This uniform distribution of cells served to indicate a force of attraction between the two portions of outgrowth.

Later, during the course of experiments with embryonic chicken heart, two fragments were introduced into the plasma drop of a slide culture quite by accident. When growth measurements were made eighteen hours later, a peculiar phenomenon was observed in the culture containing the two fragments. A very definite field of attraction was found to exist between the two pieces of growing tissue. Though this attraction field reminded us of the earlier experiments with embryonic intestine, the field itself was made visible through what appeared to be slight differences in the refractive index of the plasma clot. In some respects the rays or streamers in the plasma resembled the iron filing pattern produced by a magnet. Though some cells had already migrated from the tissue fragments, the rays visible between the two pieces of tissue were definitely not composed of elongated fibrocytes and cardiac muscle cells (see Fig. 1).

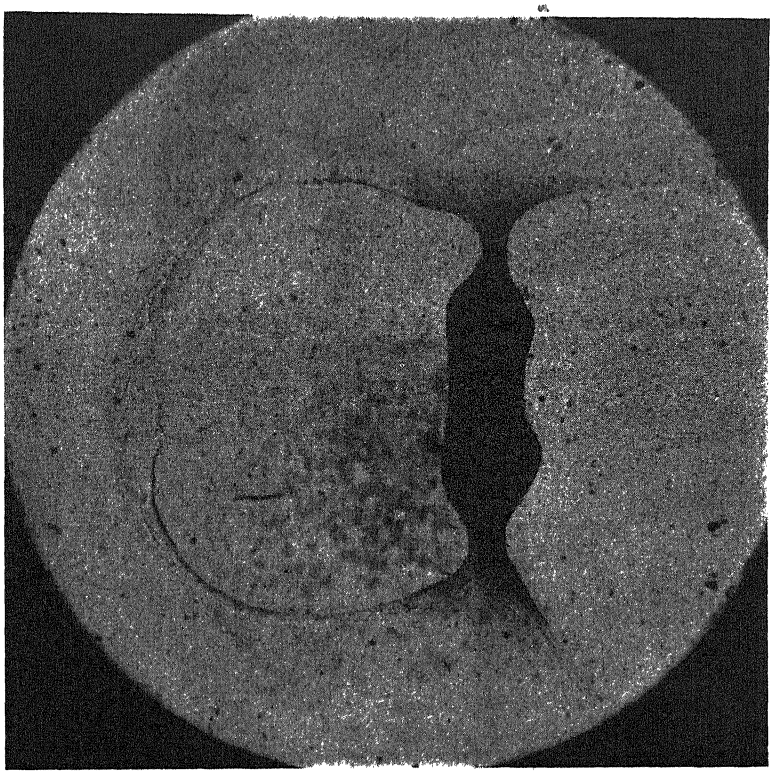

Fig. 2.

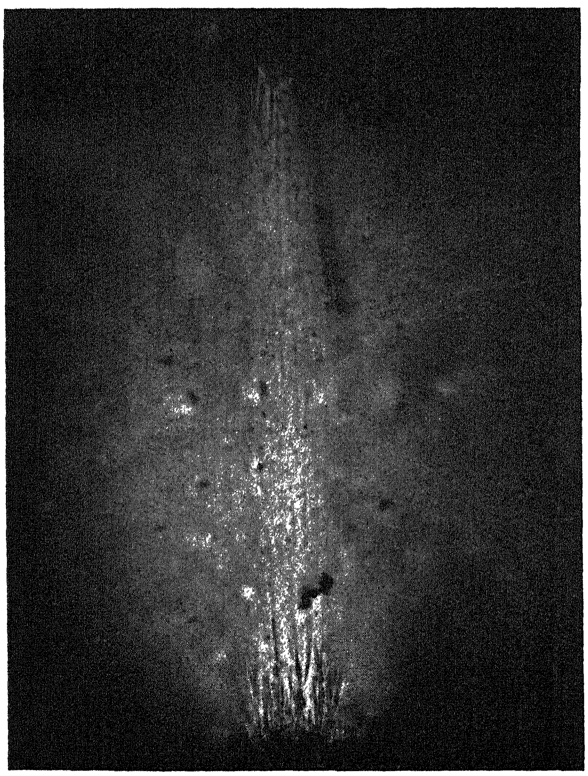

Fig. 1.

A related phenomenon of interest (in some respects similar to the outgrowth obtained with the intestine cultures) was the nature of the subsequent growth pattern within the attraction field. It is well known that isolated fragments of tissue *in vitro* usually exhibit a zone of new growth and migration in a radial fashion, that is, the cells appear to have come from the central portion of the tissue explant and continue thus into the plasma medium; however, in such cases where an attraction field was in evidence between two fragments of tissue in the plasma clot, the uniform radial growth was slightly but decidedly altered. That portion of the outgrowth which lies within the field, or from which the field seems to emanate, does not form a sector of radial growth, but is rather a bundle of elongated cells following the parallel 'lines of force'. As the cultures grow older, fibrocytes proceed from both fragments until the gap within the field is completely filled with the elongated cells.

These attraction fields have also been observed between pieces of embryo skin and liver. The fields have never been detected between a dead and a living tissue.

Though the fields were not nearly as evident nor as numerous, mouse embryo heart explanted in the same medium with chick embryo heart gave indications of a very weak field of attraction.

Though a sufficient number of cultures have not yet been prepared from which to draw conclusions, attraction fields between pieces of adult tissue have not been found.

A total of about 1,500 cultures have been prepared, and among these some 150 definite fields have been observed (Fig. 2. 113-hr. culture, 19-day chick embryo intestine. Plasma Drew).

Whether the attraction fields observed by the authors bear any relation to the plasma fibrin strands produced by Doljanski and Roulet[2] is not yet known. The experimental procedure employed by the latter investigators is quite different from our own in so far that they applied tension to plasma membranes and found cellular growths of explanted tissue oriented parallel to the fibrin strands. In our experiments, tension was not purposely applied to the plasma clot. We feel justified (for the present, at least) in ruling out any tension phenomena in the plasma clot being responsible for the observed fields. If it were a matter of tension, then it would seem reasonable to assume evidence for such in the cultures containing a dead and a living fragment of tissue. This was not found to be the case.

Further investigations are being continued in an effort to discover the true nature of these *in vitro* fields.

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Gustave Brotzge.
Sister M. Kenneth Loeffler, O.P.
Juanita Breit.

Institutum Divi Thomæ,
Cincinnati,
Ohio.
Sept. 20.

[1] Fardon, J. C., Sullivan, W. A., and Andrus, Sr. M. Basilia, *Studies Inst. Divi Thomæ*, vol. 2, No. 2, 233 (1939).

[2] Doljanski, L., and Roulet, Fr., *Roux's Arch. Entwicklungsmech. Organ.*, 131, 3, 512–531 (1934).

Occurrence of Xylans in Marine Algæ

When the red alga, *Rhodymenia palmata*, commonly known as 'dilisk' or 'dulse', was immersed in dilute hydrochloric acid for about twenty-four hours, a viscid solution was obtained and, when this solution was poured into alcohol, a white solid was precipitated from it. This substance swelled up and dissolved when put into water. After purification by three precipitations with alcohol, the opalescent solution was cleared by repeated filtration. The substance now had a specific rotation of about −87. On hydrolysis with dilute nitric acid, it yielded crystalline xylose.

This appears to be the first record of the isolation of a xylan from a marine alga, although, about seven years ago, Schmidt-Neilsen and Hammer[1] noted the high yield of furfural obtainable from *Rhodymenia palmata* and estimated the pentosan content of the plant.

Another red alga, *Dilsea edulis*, also gives a highly viscid solution on treatment with dilute hydrochloric acid; but the substance obtained from this by precipitation with alcohol was not hydrolysed to xylose. This substance appears to be an ethereal sulphate similar to those already found in other marine algæ. It yields mucic acid on oxidation with nitric acid.

These substances are being further examined and the results of the investigations will be published elsewhere.

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Oct. 19.

[1] *Chem. Abs.*, 27, 5097 (1933).

Average Gestation Period and $n\pi$

In a number of instances, average gestation periods seem to differ by a few hours only from $n\pi$ days. A few of the more remarkable approximations are:

n	$n\pi$	Average gestation period (days)	No. of pregnancies	Animal
10	31·416	31·41	64	English rabbit[1]
36	113·097	113·1 ± 0·12	203	Pig[2]
48	150·796	150·8 ± 0·13	195	Karakul sheep[3]
		150·8 ± 0·19	391	Black Forest goat[4]
49	153·938	154	?	Saanen goat[5]
92	289·026	288·9	428	Simmental cow[6]

Further data are being studied.

J. H. Kenneth.

University Union,
Edinburgh.
Oct. 10.

[1] Rosahn, P. D., *et al.*, *Science*, 79, 526 (1934).

[2] Husby, M., *Meld. Norges Landbrukshøiskole* (1933).

[3] Baranov, A. G., *Usp. zootech. Nauk*, 5 (1937).

[4] Hinterthür, E., *Züchtungskunde*, 8 (1933).

[5] Kiesling, A., *Z. Züchtg.*, 27 (1933).

[6] Indermühle, *Schweiz. Arch. Tierheilk.* (1911).

Psychology and Camouflage

Perusal of the interesting article by "J. S. H." on camouflage in Nature of October 12 leaves one rather wondering why the technical staff of the organization described should include artists, engineers, architects, chemists, physicists, photographers, and a botanist, while apparently not a single psychologist is connected with this organization. Surely the problems of camouflage are problems in perception, perhaps the most advanced field of psychological study. The fundamental laws on which camouflage must be based are partly psychological (the Liebmann law, for example, which deals with the relative differentiation due to colour and brightness, or the Wertheimer laws of organization), and it seems reasonable to ask why no use is being made of the vast amount of knowledge available.

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RESEARCH ITEMS

Prehistoric Trepanning in Europe

In connexion with the record of a trepanned skull of the Beaker Period found in a group of round barrows at Crichell Down, Dorset, in 1938, Stuart Piggott discusses the distribution of the practice of trepanning in prehistoric Europe (*Proc. Prehist. Soc.*, N.S., **6**, 1; 1940). The recorded examples show a surprising range extending from Portugal to Sweden and in time from Danubian I to the Scandinavian Iron Age (3000 B.C.–200 B.C.). The great majority, however, are concentrated within a fairly restricted area and period. In the Cevennes, a date round about 1900–1500 B.C. seems likely for the main period. This undated group of megalith builders appears to have affected profoundly the neolithic peasantry of the Paris basin. With the cult of the guardian goddess of the megalith builders of the south also came the cult of ritual trepanning, the deliberate making of holes in the skull of the living for some now obscure purpose of magic or witchcraft. Another related scalp operation was the culling of the sincipital T. With the spread of the SOM culture of the Paris basin the practice of trepanation was also introduced to other regions. The primary reason for the practice was no doubt the alleviation of pain by surgical mean. In this category may be placed the early Danubian cases, those from Scandinavian dolmens, chalcolithic skulls from Portugal and the earlier examples from the Cevennes—all possibly the result of independent invention. When, however, the practice becomes a cult it is legitimate to look for links connecting centres of concentration. Hence the cult may be traced from the Cevennes to the Seine, thence to Sweden and probably to Germany, the intensity of the cult waning in direct ratio to the distance from the diffusion point. In Czechoslovakia the group may owe its origin directly to the beaker people. The English examples are at first sight difficult to fit into a Continental series as a whole. If it may be argued legitimately that the supposedly earliest example of ritual treatment, the Maiden Castle skull, is contemporary with the skull from Crichell, both though in different contexts may be regarded as of Beaker Age as also may the Bisley skull, though derivative from a long barrow, possibly as a secondary interment. The Ovingdean specimen, however, does suggest SOM examples, and having been dredged up may be derived from across the Channel.

Toxicity of Alpha and Fast Neutron Radiation

Robley D. Evans, of the Massachusetts Institute of Technology, described the results of experiments on neutron tolerance in animals in a paper at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. He finds that the results cannot be accurately extrapolated to man because the relative radiation sensitivities are entirely unknown for small doses. Biological effects of neutrons are due to the secondary recoil rays which they produce in the body by collision with hydrogen, carbon, nitrogen, oxygen, and other atoms. The average specific ionization, and hence the ionic effectiveness, of the neutron recoil rays is closer to that of alpha rays than to any other radiation which has been the subject of extensive biological investigations. Data are available from studies of chronic radium poisoning, and of lung cancer produced by radon inhalation, concerning the effects of alpha rays on human tissue. Using these data, it is shown that a dosage of 0·01 r. per day of fast neutrons may be unsafe if the exposure continues over a period of about ten years.

Differential Periodic Theory of Growth

G. F. Sleggs (*Growth*, **4**, 1) derives the high synthetic power of protoplasm from a strained chemical cagework of genar lattices in rotational stagger. An explanation of a number of biological properties is offered in terms of the geometrical relationships arising in such a system; to those dealt with in an earlier paper are added persistence of cell bridges, division of spireme into chromosomes and the disturbance of pigmentation pattern upon salient surfaces. The extension of the staggered genar lattices produces an epigenetic pattern upon the hitherto maintained impossible basis of corpuscular preformation. The author considers that adaptation is an inherent property of the system, on the basis that rotational shift of genes brings morphogenetic gradient components into associations which determine equilibrium patterns; this shift is produced by the environment. The origin of the organism is attributed to the chemical union of lattices via an intermediate framework of amino-acid residues in such a way that the spacing of units does not correspond, producing a differentiated system with equipotential properties of regeneration and regulation.

Photosynthesis and Fluorescence

The rapid method of measuring rates of photosynthesis developed by Dr. McAlister has recently been used in a preliminary survey of the relation between photosynthesis and fluorescene during induction periods by E. D. McAlister and J. Myers (*Smithsonian Misc. Coll.*, **99**, No. 6; 1940). Wheat (var. Marquis) and *Chlorella pyrenoidosa* were used as experimental material. It was found that any sudden changes (in, for example, light intensity, carbon dioxide concentration) producing large increases in the photosynthetic rate cause a 'burst' of fluorescence. When the change is from darkness to high light this burst can be resolved into three parts: (1) the intensity of fluorescence rises to a value about equal to that of final equilibrium ($< 0 \cdot 01$ seconds); (2) a further slow rise (1 second) follows, to a position two or three times higher; (3) fluorescence decays from this maximum to the equilibrium value (1 minute). The simultaneously recorded rate of carbon dioxide assimilation follows a curve inversely related to this. At low oxygen pressures, the curves of fluorescence and rate of carbon dioxide uptake are in fact almost exact mirror images (as to time). In both wheat and Chlorella it appears that the changes in carbon dioxide assimilation during the induction period under normal air conditions are, however, caused by two processes, one inversely (as above) and one directly related to intensity of fluorescence. The dependence of this second type on oxygen pressure, and the observation of greater carbon dioxide uptake under low oxygen pressures, suggest that this second

type of reaction is a photo-oxidation. In Chlorella acclimatized to low carbon dioxide, the photo-oxidation type of reaction predominates. Under steady state conditions following the induction periods, a marked change in fluorescence occurs on passing from light-limiting to carbon dioxide – limiting conditions. The rate of carbon dioxide assimilation in wheat in high light and 0·03 per cent carbon dioxide is 30–50 per cent higher in 0·5 per cent than in 20 per cent oxygen. This suggests that in young wheat a reaction of large proportion opposing photosynthesis is always active under natural growing conditions.

Smut Resistance and Interchanges in Maize

C. R. Burnham and J. L. Cartledge (*J. Amer. Agron.*, **31**, 924–933 ; 1939) utilize lines carrying reciprocal translocations to discover the loci of genes for susceptibility of maize to smut. Each line was crossed to a resistant line and the F_1 backcrossed to a susceptible line. Linkages were observed between smut resistance and the interchanges $T_{1\text{-}2c}$, $T_{1\text{-}6a}$, $T_{1\text{-}9c}$, $T_{2\text{-}6a}$, $T_{3\text{-}8a}$, and $T_{6\text{-}8a}$, and probable linkages with other translocations. It is probable that the locus of the translocation breaks in chromosome 2 involved in $T_{1\text{-}2c}$ is linked with smut resistance and that in the remaining cases the break-loci of one or both chromosomes is linked with smut resistance. The procedure to be adopted for analysis by means of reciprocal translocations is outlined.

Polyploids in Cotton

S. C. Harland (*Trop. Agric.*, **17**, 53–54 ; 1940) has doubled the chromosome number of various cotton species and their hybrids by the use of colchicine. He shows that octoploids have an increased cell size as compared with the tetraploids, but the hairs, while larger, are too weak for economic purposes. On the other hand, synthesis of allotetraploids which will cross with the forms of *G. barbadense* and *G. hirsutumn* will be useful. Since *G. Thurberi* carries immunity to Pink boll worm, the allotetraploid *Thurberi* × *arboreum* is of great economic advantage. Similarly hexaploids raised from the hybrids *barbadense* × *aridum*, *barbadense* × *Thurberi*, and *barbadense* × *Armourianum* give promise of resistance to drought, diseases and insects.

Tertiary Volcanic Rocks of Victoria

A. B. Edwards and W. Crawford have made a valuable field and petrological study of the volcanic rocks which cap the Gisborne Highlands in Victoria (*Proc. Roy. Soc. Victoria*, **52**, 281–311 ; 1940). The volcanic complex of Mount Gisborne is built up of a series of hypersthene-trachyandesites and hypersthene-bearing basalts in addition to a variety of normal types. The trachyandesites and associated rocks contain more or less resorbed phenocrysts of felspars and hypersthene and also numerous xenocrysts of quartz, presumably derived from the sediments through which the magma had passed. These lavas present the apparent anomaly of a 'tholeiitic process of differentiation' superimposed on the normal (trachytic) process. It is suggested that this local change in the character of the differentiation was brought about by local assimilation of sediments, whereby the parental basaltic magma became saturated with respect to silica. A similar hypothesis has already been proposed to account for the trachyandesites of the Coliban district of Victoria (*Q. J. Geol. Soc.*, **94**, 243–320 ; 1938). Effective comparison of the suite of volcanic rocks under discussion is made with similar suites from the Circum-Japan Sea Province, Kerguelen Island and Ascension Island.

The Imperial Valley (California) Earthquake

The Imperial Valley earthquake of May 18, 1940, has been classed as fifth in the list of destructive earthquakes in the history of America (*Earthquake Notes*, **22**, Nos. 1 and 2, September 1940). Its direct cost has been estimated at some five or six million dollars, as compared with about twenty-five million dollars for the great San Francisco earthquake of 1906. The epicentre of the recent shock was near Brawley, where considerable destruction was done to parts of the water and sewer systems, though more buildings were damaged at Imperial. Well-constructed steel and reinforced concrete buildings did not suffer so much as the poorly constructed buildings and those made of adobe. An intensity X was reached on the modified Mercalli scale (some well-built structures destroyed, ground badly cracked, rails bent, landslides, etc.). Roads and bridges were damaged and one bridge had to be closed. Direct loss of life was only nine though scores were injured, and the shock was felt over an area of 60,000 square miles. The strong-motion instrumental record at El Centro, California, indicated that the horizontal acceleration of the ground during the earthquake was approximately one third that of gravity at El Centro, though the record is incomplete as the spot of light was thrown off the paper at both sides. At one point in the area the permanent horizontal ground displacement was about 12 ft., and a vertical displacement of 3 ft. has been found. In general, where slippages occurred at the surface, the movement was north-west for the west side of the fault, a condition that generally occurs in Californian earthquakes. A surface fault apparent after the shock could be traced in an almost straight line for more than 40 miles. More than thirty-five aftershocks were felt at intervals over a period of more than a week.

Precipitation of Colloids by Electrolytes

It is known that the concentration of electrolytes required to coagulate hydrophobic sols varies with the sol concentration. Burton and Bishop suggested that the precipitating values of univalent, bivalent and tervalent ions increase with, are independent of, and decrease with the sol concentration, respectively. Ostwald introduced the rule that the activity coefficients of various precipitating ions are constant at their precipitation values. H. B. Weiser and W. O. Milligan (*J. Amer. Chem. Soc.*, **62**, 1924 ; 1940) in an investigation of relatively pure sols of copper ferrocyanide, ferric oxide and arsenic trisulphide have shown that neither rule has any general validity. The slope of the precipitation value – sol concentration curve depends upon the adsorbability of the precipitating ions, the stabilizing effect of the adsorption of ions of the same sign of charge as the sol, and the purity of the sol. Burton and Bishop's rule may be restated in the form that for a given sol the *proportionate* increase in stability towards precipitating electrolytes or dilution is in general greater for electrolytes with univalent precipitating ions than for electrolytes with multivalent precipitating ions, and is greater the higher the purity of the original sol. Ostwald's rule did not apply to the observations at any concentration of sol.

PRACTICAL ASPECTS OF EARTHING

IN the October issue of the *Journal of the Institution of Electrical Engineers* the important joint paper compiled by E. Fawssett, H. W. Grimmitt, G. F. Shotter and Dr. H. G. Taylor, on practical aspects of earthing, is published in full, together with the relevant discussion of the Transmission Section.

Particular attention is given to the methods of earthing the networks of supply stations so as to prevent dangerous high potentials occurring at any point. According to the definition given in the Electricity Supply Regulations, "connected with earth" means connected with the general mass of earth in such a manner as will ensure at all times an immediate and safe discharge of energy. The authors say that it is sometimes found that it is difficult to make a connexion with the general mass of earth in such a way as will ensure at all times a safe discharge of energy, depending as it does on the conductivity of the soil and the position of lakes, rivers, etc., in the neighbourhood.

In the discussion, Mr. J. F. Shipley appreciates the authors' suggestion that engineers should use geological drift maps, but points out that they have to be used with care as they are always made on a very large scale. With regard to the subject of rainfall, he said that in Great Britain it is very satisfactory from the point of view of earthing; there is plenty of it all the year round but not too much. Mr. Shipley has had experience of countries where the annual local rainfall is 400 inches and it nearly all falls within two or three months; the rain is so heavy that it sometimes completely washes the earth connexion away. The rain water is itself of very low conductivity, and as it falls in such quantity it acts as a leaching agent and washes all the conducting salts out of the soil, so that although the soil is soaked with the water in the wet season, it is still a bad conductor.

Figures are quoted bearing on this point. The condensate in a modern turbo-generating station has a conductivity figure (the reciprocal of megohms per cm. cube) of about 2. London rain water has a conductivity figure of about 390, and Glasgow water of about 120. Manchester water, one of the softest on record, has a conductivity figure of 48, and sea water a figure of 50,000. In one case Mr. Shipley found the conductivity of the water to be of the order 18; this was after six months storage in a reservoir and a five or six mile journey along a river bed. He estimates that the original conductivity figure was about 10. When, therefore, heavy rainfall occurs in atmospheres that are comparatively free from dust and pollution, the rain water is an almost perfect insulating material. He found this out in a practical way by trying to test a 6·6 kv. alternator on a testing tank. Ordinary water from the hillside was used, and it was found that with electrodes in water three feet apart there was not the slightest sign of current passing between them.

A case was also described where considerable damage was done by lightning to a lead-covered cable in the dry climate of South Africa. The cores were repeatedly damaged by discharges within the cable which coincided with lightning strokes striking the ground some distance away. In Great Britain we are accustomed to think that if lead-sheathed cable is buried in the earth, the conductor inside is safe from external discharges, but this incident shows that this is not the case. Owing to the dryness and high resistivity of the soil, the earthing secured by the cable being buried was insufficient; and the cable is now being additionally earthed at intervals by pipe-earths.

Mr. P. B. Frost pointed out that telephone cables are damaged by lightning in Great Britain as well as in Africa. In one case, a long main underground cable not connected in any way with overhead lines developed about ten faults distributed over some miles, due to lightning discharge between the sheath and the conductors.

THE ACOUSTIC AIR-JET GENERATOR

IN 1916, Prof. Hartmann, of Copenhagen, while exploring with a Pitot tube the distribution of total head in a high-speed jet of air, observed that the pressure along the axis of the jet underwent a cyclic variation with its distance from the discharge nozzle. This so-called Pitot curve, shaped like a sine wave of diminishing amplitude, comprises successive wave-lengths along which the pressure is alternately falling and rising. It was found that the intervals of rising pressure were unstable. When, for example, the pressure over these regions was explored with a wide Pitot tube, unstable readings were obtained, indicating that the air in the jet alternately entered and was discharged from the tube with a regular frequency. The same phenomena occurred when the open end of a hollow vessel or oscillator' was mounted in a rising pressure of the air jet, the result with this arrangement being the production of vigorous sound waves varying in frequency according with the volume of the oscillator and the size of its open end.

In *Engineering* of October 18, it is stated that Prof. Hartmann has spent several years in developing an acoustic sound generator based on this principle. In his researches he has been assisted by three other physicists and supported financially by Danish endowments. The generator was described and demonstrated by Prof. Hartmann at the Blackpool meeting in 1936 of the British Association.

The final account of Prof. Hartmann's work, now issued in English as No. 4 of the Ingeniorvidenskabelige Skrifter (Akademiet for de Tekniske Videnskaber ok Dansk Ingeniörforening), covers a good deal of experimental research hitherto unpublished

in English, and presents complete data and theoretical analyses immediately useful to research workers in acoustics.

It appears that the fundamentally scientific aspects of the generator and its mode of operation have been adequately covered. Except for its obvious utility as a source of controllable sound for acoustic research, the authors in this paper put forward no specific suggestions for applying it usefully in engineering or other industries, although in previous accounts they have discussed its possibilities for precipitating smoke and dust in the atmosphere and for producing supersonic vibrations which might be employed for testing the quality of materials. Its potentialities as a means of communication and for transmitting supersonic energy through the air will also warrant the closest consideration. But over the audible range of frequency the Hartmann generator is faced with the opposition of a host of already firmly established competitors. The article concludes by saying that the reticence of the inventors on new ways and means of augmenting the sufferings of a noise-tormented world has much to commend it.

FEMALE SEX HORMONES*

The Ovarian Follicular Hormones

By Prof. E. A. Doisy, St. Louis University

The ovarian follicular hormone, manufactured in the ripening follicle of the ovary, is one of the so-called œstrogenic hormones—chemicals which cause the female to exhibit mating behaviour. In the human and in other animals the œstrogenic hormones prepare the lining of the uterus for the reception of the fertilized egg, stimulate the development of mammary glands, and at the time of birth activate the womb.

Of more practical interest, however, are the remarkable therapeutic benefits obtained with these hormones in a variety of conditions. Some of the most striking results have been achieved in ameliorating the effects of the menopause and in correcting various disorders associated with the sex cycle.

Doisy and associates were the first to isolate an œstrogenic hormone in crystalline form in 1929. The substance, which was called theelin, was extracted from human urine. Later it was isolated from numerous other sources.

While theelin is produced in the ovaries and, during pregnancy, in the placenta, the hormone is much more easily extracted from the urine. The first yield from this source was only 1·5 mgm. It was not until 1935 that Doisy, MacCorquodale and Thayer were able to extract the œstrogenic hormone from the organs themselves, and in this work they used four tons of ovaries from sows. It took two years to obtain enough of the pure compound for thorough chemical and biological characterization, for the concentration existing in the swine ovary was only 6 mgm. per ton, or about one part in 150,000,000. The pure material was named α-dihydrotheelin, differing from theelin only in the addition of two more hydrogen atoms. In obtaining the substance from human material, one worker used 702 full term placentas, which were obtained at childbirth and which weighed altogether a half ton.

Prof. Carl Bachman synthesized theelin in 1940 from simple organic compounds, an achievement which may be described as one of the outstanding accomplishments in the sex hormone field. This and other œstrogenic hormones prepared synthetically are so much cheaper than the products obtained by necessarily tedius extraction of the natural material that the therapeutic use of the compounds is increasing.

Toxic effects are, however, reported by some physicians using synthetic hormones, and it is to be hoped that chemists may be able to remove the toxicity without producing loss of the œstrogenic property.

The Gonadotropic Hormones

By Prof. P. E. Smith, Columbia University

Intensive study of the interaction between these particular members of the endocrine system, namely, the pituitary and the sex glands, began about thirteen years ago, when it was discovered that the sex glands were not independently functioning organs but were dependent upon some unknown but essential *X*-substance for their maintenance. It was next revealed that this *X*-substance which stimulated the sex glands was supplied by the anterior lobe of the pituitary gland (also known as the anterior hypophysis).

In rapid succession three rich sources of gonad-stimulating (gonadotropic) substances were found. One was the urine of pregnant women. One was the urine of women who had had their ovaries removed or who had passed the menopause. The third was the blood serum of pregnant mares. The effects of these substances were observed not only by clinical use in various disturbances of the normal cyclical behaviour of the female sex glands but also in laboratory tests upon animals—principally rats and monkeys—the pituitary glands of which had been removed.

One of the early complications in this study was the fact that all species do not react identically or even similarly. Also extracts of pituitary glands from various species of animals gave different responses on one species of test animal. These differences early gave rise to the concept that the somewhat different effects were due to the presence of more than one gonadotropic hormone in the pituitary.

In 1931, Dr. Frederick L. Hisaw and Dr. H. L. Fevold, of Harvard, announced they had obtained two gonadotropic fractions from the pituitary gland of the sheep. One they called the *FSH* (follicle stimulating hormone) and the other became known as the *LH* (luteinizing hormone). According to their theory, which was supported by several other workers, the *FSH* causes growth of the follicle in the ovary. The œstrogenic hormone of the follicle in turn influences the pituitary and causes secretion of the *LH*. When the two pituitary hormones are in proper

* Substance of a symposium held at the Bicentennial Conference of the University of Pennsylvania on September 18.

balance, ovulation occurs and then the *LH* causes formation of the corpus luteum, the yellow body which fills up the place formerly occupied by the ovum before it was extruded by the erupting follicle.

A number of recent researches have cast doubt on the existence of these two separate gonadotropic hormones of the pituitary, and suggest that the different types of response in the test animals may be due to the differing rate of absorption of the hormone.

The maintenance of the gonads is complicated even if it is effected only by a single gonadotropic hormone and if only one sex and one species of animal is considered. If it is due to two hormones the situation becomes very much more complex. Although some thirteen years have elapsed since the subject began to be intensively studied, nevertheless it appears that little more than a start has been made in securing an understanding of the many factors involved.

EXACT SCIENCE IN ANTIQUITY*

CONTACT between highly different cultures apparently gave the impetus to important developments in the early history of the exact sciences, namely, mathematics and astronomy. The development of exact science cannot be adequately described as a systematic step-by-step progress. In any event where we are able to disclose the conditions of essential new development, the contact between highly different cultures appears to give the initial impetus. On the other hand, 'culture' is in itself equivalent to tradition, which unifies large groups of populations into a common type of opinion and action. However, the same force, tradition, which defines a culture as an individual being, becomes an increasing impediment to further independent development and creates the long periods of 'dark ages', which cover by far the largest part of human history.

The mathematical texts of the First Babylonian Dynasty, that of King Hammurabi (about 1800 B.C.) treated elementary geometrical problems in a very algebraic form. This rise of the abstract representation in mathematics may be attributed to a historical event, the complete replacement of the Sumerians by the Semitic population.

The Semites, coming into the land of the Sumerians, began to write their own Semitic language with the Sumerian picture script. The Sumerians used a single sign for a single concept (ideograms). The Semites took the signs and used them in two different ways: first, in their old sense as representations of single concepts, and secondly, as pure sound symbols (syllables) for composing their own words phonetically.

Using the symbol to represent a single concept corresponds in the field of mathematics exactly to our algebraic notations. Instead of writing 'length' with six letters, for example, it was sufficient to write a single letter 'L', or instead of writing out 'plus' or 'addition', it was sufficient to use one single sign +.

Evidently the idea of this algebraic form of mathematics occurred to the Semites when they saw the single symbol or ideogram form of writing alongside their own phonetic system. We see here again how an entirely unconscious external influence caused the second fundamental invention of 'Babylonian mathematics', the 'algebraic' notation. Without such a deep linguistic difference such a powerful instrument as ideographic notation for mathematical operations would never have been introduced, as the parallel with Egypt clearly shows.

An atmosphere of general learning conducive to improvement along many lines of scholarship and science was created by the necessity of translating the language of the original occupants of this section of Mesopotamia to that of the new rulers. Systematic philological schools were created, and their existence is recorded by the large collections of word lists, grammatical rules, etc., used in the translation of Sumerian to Semitic.

Later in the history of Babylon, when it was conquered by the Assyrians, who constructed a powerful kingdom reaching from Persia to Egypt, politically powerless Babylon became an admired cultural centre of a world-wide empire, comparable to the position of Rome in medieval times. Persian priests, Jews, and Greeks lived in Babylon, and used Aramaic as an international language. There arose competition between the national cultures, for example, Zarathustra, Abraham and Pythagoras were each proclaimed as the inventor of all science and creator of astronomy, astrology, and number-wisdom, and each group asserted itself to be the oldest and consequently the teacher of mankind. This atmosphere of intellectual competition stimulated further development of Babylonian astronomy. This new astronomy was based not on old observation of miraculous exactitude, as usually pretended, but, on the contrary it reduced the empirical dates to the utmost minimum, mainly period relations, which are easy to observe and almost unaffected by the inexactitude of single instrumental observations.

Ptolemy (100–180 B.C.) was one of the greatest scholars of all times. High tribute should be paid to the supreme mastership and independent judgment exhibited in Ptolemy's "Almagest" on mathematical astronomy, his "Tetrabiblos" on astrology, and his "Geography".

The main school of geographers, however, did not follow Ptolemy, but preferred general descriptions of different regions and their population to the more fundamental problem of exact mapping, which involved astronomical observations for determination of geographical position. This tendency toward popular representation was one of the main reasons for the rapid decline of ancient exact science, and it finally created the race of commentators, who killed any kind of independent thinking with their tedious explanations of every little step.

The sexagesimal system of the Sumerians, in which the unit represented powers of 60, such as 60 itself, 3,600 or 1/60 is worthy of note. (We have a remnant or suggestion of the sexagesimal system in our clock dial of 60 seconds to the minute and 60 minutes to the hour.)

The Sumerians at first represented the units of different powers to 60 by a difference in size of the symbol, but later this careful notation was omitted, and 'place value' notation was initiated, the ancestor of our present decimal number system.

* Substance of a paper read by Dr. Otto Neugebauer at the Bicentennial Conference of the University of Pennsylvania on September 17.

WORK OF THE IMPERIAL INSTITUTE

By Sir Harry Lindsay, K.C.I.E., C.B.E.,

Director, Imperial Institute

Dr. Collinge's account, published in Nature of October 19, p. 526, of the work of the Philadelphia Museum shows that it follows lines closely analogous to those adopted by the Imperial Institute in the display of raw materials (in our case, of the British Empire) and the 'story' of their transformation to finished goods. The Institute is also a bureau of technical information based not only on investigations carried out in our own laboratories but also on information available from technical and trade journals in all languages.

Unfortunately, our exhibition galleries and cinema have had to be closed under war conditions. We still continue, however, to send films of the Empire on loan to schools and societies throughout the United Kingdom. In place of our series of lectures on the overseas Empire, which used to attract many hundreds of school parties to our cinema, we have adopted a scheme whereby a panel of Empire lecturers is made available to primary and secondary schools in reception areas. Our latest development is to try to transfer, with the help of our artists, the 'story' of the transformation of raw materials into finished commodities from showcases in our galleries to posters which will be made available to schools together with lecture notes to accompany them.

With regard to our technical intelligence bureau, the Institute's staff includes tropical agriculturists, chemists, chemical technologists, economic botanists, economic geologists, mining engineers, mineralogists and statisticians, all of whom are expert in their particular subjects. When desirable, the Institute seeks the advice of members of its fifteen consultative committees, which comprise authoritative professional and business men. Further help is also afforded by numerous trade contacts.

The Institute also has an extensive reference library and a technical index covering most of the relevant trade and scientific publications issued during the past thirty years.

Examples of the type of inquiry dealt with at the Institute include the following: Inquiries relating to sources of supply of raw materials and semi-manufactured products whether of animal, vegetable or mineral origin in all countries; inquiries relating to the marketing of overseas products; detailed statistics of production, consumption and trade in all countries; questions concerning the normal uses of all raw materials and most semi-manufactured products and discussions concerning possible new or alternative uses; inquiries concerning the specifications as to qualities and types of raw materials necessary for various purposes; questions arising out of a desire to substitute one commodity for another; details of the methods employed in the cultivation of crops and the soil and conditions under which they have to be grown; details of the methods employed in mining, smelting and dressing minerals for the market; methods of processing and preparation for the market of animal and vegetable products, and particulars of machinery and equipment used for these purposes; details of the location and plant capacity of works at which smelting or refining or other processing is carried out; analysis and testing of samples of raw materials in the laboratories of the Institute.

FORTHCOMING EVENTS

Monday, November 11

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. Dudley Stamp: "Productivity and Classification of Land in Britain".

Wednesday, November 13

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. K. G. Fenelon: "Some Problems of Wartime Labour Management."

Thursday, November 14

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Prof. A. Fleming: "Antiseptics in Wartime Surgery".

Friday, November 15

North-East Coast Institution of Engineers and Shipbuilders (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Dr. G. S. Baker: "Vibration Patterns of Propeller Blades".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Two Graduates in Engineering at the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (November 13).

Head of the Electrical Engineering Department at the Chesterfield Technical College—The Clerk to the Governors, Technical College, Infirmary Road, Chesterfield (November 16).

Headmaster of the Shipley Art School and Headmaster of the Shipley Technical Institute (combined appointment)—The Secretary to the Managers, West Riding County Council, Town Hall, Shipley (November 20).

Trained Graduate Assistant Master to take Chemistry, and Assistant Master for Engineering Subjects—The Head Master, The Modern School, Cole Street, Scunthorpe, Lincs.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

East African Agricultural Research Station, Amani. Annual Report, 1939. (Colonial No. 180.) Pp. 26. (London: H.M. Stationery Office.) 6*d*. net. [2210

Wool Industries Research Association. Animal Fibres of Industrial Importance: their Origin and Identification. By A. B. Wildman. Pp. 28+23 plates. (Leeds: Wool Industries Research Association.) [2310

Other Countries

Indian Forest Records (New Series). Silviculture, Vol. 3, No. 8: A Note on the Artificial Regeneration of the Dry Fuel Forests of the Madras Province. By A. L. Griffith. Pp. vii+291–322. (Delhi: Manager of Publications) 1.14 rupees; 2*s*. 9*d*. [1410

Indian Association for the Cultivation of Science. Annual Report for the Year 1939. Pp. 44. (Calcutta: Indian Association for the Cultivation of Science.) [1410

U.S. Department of Agriculture. Miscellaneous Publication No. 354: A Review of the Parasitic Wasps of the Ichneumonid Genus *Exenterus* Hartig. By R. A. Cushman. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents. [1510

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 13: Four Hundred Word Chin Tan of Chang Po-Tuan; Three Alchemical Poems by Chang Po-Tuan; Shih Hsing-Lin, Disciple of Chang Po-Tuan and Hsieh Tao-Kuang, Disciple of Shih Hsing-Lin; The Secret Papers in the Jade Box of Ch'ing-Hua, and A Fifteenth Century Chinese Encyclopedia of Alchemy. By Tenney L. Davis and Chao Yun-ts'ung. Pp. 371–400. 1 dollar. Vol. 73, No. 14: Gyromagnetic Ratios for Ferromagnetic Substances; New Determinations and a New Discussion of Earlier Determinations. By S. J. Barnett. Pp. 401–456. 1.75 dollars. (Boston: American Academy of Arts and Sciences.) [1510

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Talc, Steatite and Soapstone; Pyrophyllite. By Hugh S. Spence. (No. 803.) Pp. vii+146+8 plates. (Ottawa: King's Printer.) 50 cents. [1510

NATURE

Vol. 146 SATURDAY, NOVEMBER 16, 1940 No. 3707

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number: City 4211

Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

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WELFARE OF YOUTH

ONE of the most remarkable developments that the War has brought has been the concentration of interest on the so-called youth movement. This has been due in large measure to the increasing attention that is being devoted to the question of maintaining good standards of health during the periods of early and late adolescence in order that the valuable work performed by the school medical services might not be undone before maturity is attained. The transitional period marking a young person's introduction to industrial life is properly regarded as being critical from the health point of view, and every attempt at improving those facilities which promote the cultivation of positive attitudes towards health and conduct is bound to receive sympathetic consideration as an effective means in the building of character. Unfortunately, many individuals who bear the responsibility for safeguarding the interests of youth, and particularly some who have voluntarily undertaken work in the various youth organizations, have become extremely suspicious that the attention which is being given to the fourteen to twenty age-group has been artificially engendered with the sole object of providing recruits of a better standard of fitness for the armed forces, and that the continuance of the interest is unlikely to survive when the peace comes (see p. 647 of this issue). This must never be; the object of any youth movement must be to produce citizens worthy in mind and body of a worthy heritage.

Yet the circulars, "The Service of Youth" and "The Challenge of Youth", issued by the Board of Education during the past year, have, in a few cases, served to strengthen this suspicion because of the emphasis given in them to physical education. Where the circulars have been read in the spirit with which they were written, however, all doubts on this point are readily dispersed. The Board of Education must be credited with having made a genuine attempt to point the way towards the development of a youth movement which should not only become well established during the War, but would also form a highly significant and invaluable means of reconstruction in the peace which is to come.

A more widely held suspicion on the part of youth leaders relates to the steps which the Board of Education has taken in order to encourage interest in questions pertaining to youth. The setting-up of the National Youth Committee soon after the outbreak of War was greeted with acclamation by the many but with very real apprehension by a vociferous minority. The latter regarded this pronouncement as but the first of a series which would lead eventually to what they imagined would be the compulsory regimentation of youth and gradually to the superceding of all voluntary activity and initiative. In no way does one wish to subscribe to this point of view, but it must be said that the situation has been allowed to continue in such an atmosphere of doubt and uncertainty that the National Youth Committee has, by its own unbroken reticence, contributed in great part to the present state of confusion. The position needs immediate clarification if the services of many of the already active youth leaders are to be retained, and if, as is so urgently required, we are to see the extension of the youth programme according to a national policy.

The function of the National Youth Committee appears to have been as carefully concealed as has

been its constitutional powers and terms of reference. From time to time statements from individual members of the Committee appear in the educational Press but little evidence is forthcoming that the Committee is actively working. The statements themselves are usually of a complacent nature, and express considerable satisfaction at the way the voluntary youth organizations are promoting activities which will guide the young people of the country to fuller and richer lives. One cannot fail to accord a grateful sense of appreciation for the work being carried out by the voluntary organizations; but many of their own workers are seeking both the direction in which the youth policy is to proceed and means to promote the efforts required. This was expressed very clearly recently in a journal devoted to the interests of a boys' movement, when a writer remarked that the only certain fact about our national youth policy was its non-existence. The difficulties confronting those individuals who are only too anxious to undertake service for youth demands confronting with a resolution born of imagination and matter-of-fact realism. In both respects the National Youth Committee could do more to retain and improve the active support of youth workers.

The problem of dispelling doubts about regimentation is one that will demand the use of considerable tact and discretion. In a recent statement in the House of Commons, the President of the Board of Education stated categorically that the last development he wished to see was a centralized movement with rigid uniformity and standardized practice, which placed older boys and girls under the control of some super-functionary in the central Government. Mr. Ramsbottom's disclaimer about militaristic interpretations of the youth scheme was equally strongly worded. It is to be hoped that the action taken, based on these utterances, will serve to dispel the fears of youth workers and to secure their continual and ungrudging support. Probably much of the existing confusion about regimentation lies in the lack of distinction between freedom and discipline. Nevertheless, to establish this distinction to the satisfaction of democrats is not so easy. The main aim should be to fuse the two. Lack of discipline will obviously lead to chaos, and on the other hand absolute freedom is undesirable for it implies freedom of action, expression of opinion, etc., whether right or wrong. Much time is often wasted by the expression of conflicting opinions concerning a problem which to a balanced mind is already settled. There can be few more exasperating than he who claims his freedom to express his opinion merely in order to argue for argument's sake.

The plight of many youths of both sexes who are 'free' to walk aimlessly about or lounge at corners or in queues with no sense of meaning or purpose in life is too well known to need further comment. The most conservative estimates suggest that at least 60 per cent of our young people have no connexion with any single organization, educational, social, or religious. War work has given most of them employment but has not solved their leisure problems and, in some cases, has only intensified them. Their difficulties will not be entirely solved by the extension of the physical fitness scheme on the lines proposed by the Board of Education, nor even by the provision of opportunities for extending their social and cultural interests. Youth needs a sense of significance in life for the individual and the community; suspicions about regimentation need offer no excuse for lack of guidance. The necessity for imaginative planning and disciplinary action is clearly indicated. Already, many youth leaders are advocating compulsory attendance for all young people at some kind of youth organization. At the moment, the execution of such a proposal is probably unwise and equally impracticable; but, as a matter which will inevitably grow in intensity, merits earnest consideration. Its proponents have the fact of compulsory school attendance up to the age of fourteen years to strengthen their case. They are asking, almost with passionate conviction, why, in the most formative years of their lives, when they are acquiring those habits of body, mind and spirit which determine their whole usefulness to themselves and to the community, the majority of our future citizens should be left to the influence, good or bad as it may be, of their surroundings. Whatever the policy adopted it is essential that the spirit of the voluntary organizations with its enthusiasm and informality should be retained and used as the basis for all future developments.

Another matter upon which clearer light might be thrown relates to the activities of local youth committees. Apart from one or two recalcitrant authorities, who may need disciplinary action to call out their initiative in planning for the welfare of the youth of their area, it appears that these committees have now been formed under the ægis of each local education authority. Their con-

stitutional powers, aims, and methods of working have been left to local incentive. Already there is ample evidence that, owing to the cautious utterances of the Board of Education, a great sprawling organism is being formed, both unwieldy and uncontrolled. In some cases these youth committees have been constituted merely in an advisory capacity to the local education committee and themselves possess no statutory powers. In others, sub-committees of local education committees have been formed with full statutory powers, while in yet others entirely independent committees have been created. Whatever the method of constitution, it would seem essential for smooth and successful working that these committees be given sufficient elasticity to allow them to develop their planned programmes without being held too tightly under the control of the education committee. At least one secretary-organizer to each committee would appear the necessary minimum for administrative supervision, while it should be strongly urged that religious leaders with experience in youth work should be given greater representation than has hitherto been apparent. Discreet guidance, combined with more dynamic leadership from the central government, would do much to unify the existing diversities and would serve to stimulate retrograde or passive committees into action which is so urgently required.

The calling into being of these youth committees appears to have proceeded so smoothly—albeit scarcely rapidly—that the complacent references in the Press appear to be well merited. In practice, many local authorities have travelled no farther on the road towards the service of youth than was evident a year ago. Credit must be freely given to those authorities who for some months have been actually promoting youth work. Their enthusiasm and progress should serve as a salutary reminder to the greater number of youth committees, who, up to the present, have functioned in name only. The proposals outlined by the Board of Education a year ago should have been carried to a riper stage than has been reached to-day.

Co-operative understanding between youth committees and the voluntary organizations should do much to promote the welfare of youth. On their side, the youth committees should play their part in seeing that emphasis must never be placed on the consolidation of youth work but on its extension and development. The challenge to the youth organizations will be in seeing that the quality of local work is such that it cannot fail to stimulate youth committees to increasing and active support. In many areas, prominent educationists have been self-confessedly amazed at the quantity and quality of youth work that has been carried out in their own areas for some years past without their knowledge. With the collaboration of the educationists, far-reaching measures can be taken to secure the extension of instructional, cultural, and social facilities of all kinds. Vigorous co-operation with the youth committees should allow the voluntary organizations to become doubly active in promoting courses for the equipment of potential youth leaders. The youth leaders themselves should be continuously engaged in pursuing enquiries as to the needs, interests, industrial occupations, home and surrounding conditions, as well as the usual leisure activities of youth. (In this connexion the parts played by the public cinemas and radio as educative processes must not be forgotten or minimized.)

The need for the carrying out of scientific surveys—similar to the one in progress in Manchester and Salford at present—is of overwhelming importance. Where these surveys are not being envisaged, however, youth leaders can, by discreet inquiry, secure information that will become of increasing value if carefully collated. When the nature and extent of the youth problem has been established, it is to be desired that an intensive drive should be launched to persuade boys and girls unattached to youth organizations to become active participants in youth centres. This drive may eventually become one of personal recruitment before the adolescent has left school. A considerable augmentation of existing youth services would be needed to cater for this project.

One factor which inevitably must serve to promote greater effort in the youth field would lie in a better appreciation by society at large of the amount of work already achieved by the national voluntary organizations. A deeper realization on the parts of educationists, men of science, and all other members of the community that the work in boys' and girls' clubs, etc., is no mere side-issue carried out by zealous individuals with little else to do, would contribute greatly to the extension of youth welfare. The comprehensive development of the national youth movement will rest upon the rapidity with which its absolute necessity and importance becomes impressed upon the mind of the general public.

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The Subject Index to Periodicals, 1939
Issued by the Library Association. Pp. xi + 270. (London: The Library Association, 1940.) 77*s*.

HOW seldom do those engaged in developing a new idea for the national effort pause to consider the patient drudgery expended daily in the production of the bibliographical guides whereby to cull the information recorded about that idea. Still less often do they inquire whether these bibliographical aids to research are organized to provide the whole of the relative information recorded. We realize the necessity of finding the best brains for war-time research; but we fail to understand the basic value of a complete index to scientific and technical knowledge. Nor do we appreciate the facts that such an index is not to hand, and that we are wasting time and human lives in repeating work already on record, if we could but find it. The bibliographical work and its organization are accepted as a matter of course. Nothing less than their sudden death seems likely to awaken the necessary interest; though, in war-time, special arrangements have to be made to prevent this calamity, while completeness of the work becomes especially needful.

In regard to the latter desideration, there are two methods by which the fifteen thousand scientific and technical periodicals containing useful articles, published currently in Great Britain and abroad, can be scrutinized regularly and have their worth-while papers abstracted or indexed. Each periodical can have its articles dealt with, working from the beginning to the end of each number as it appears; or, the whole mass of periodicals can be searched from the point of view of each particular branch of knowledge, and those articles relative to each branch picked out. The former method insures that every article is noted; the latter involves greater labour and the risk of missing articles on each subject that appear in periodicals devoted to other subjects, remotely related.

The former method was adopted by the International Catalogue of Scientific Literature. It is the method that appeals to librarians in seeking to catalogue the literature in their libraries. This is the method chosen by the Library Association for the "Subject Index to Periodicals", edited by J. Rowland Powel, of which the 1939 volume is before us. The periodicals indexed in this volume comprise a selection of 577 English and foreign journals and transactions of societies, filed in a number of libraries all over the British Isles, the names of which are quoted in the 1937 and 1938 volumes of this index. The current volume contains some 40,000 references, referring in the main to articles of scientific and technical interest. Verse and fiction are not included. Brief annotations are added to titles not sufficiently indicative of the subject of the articles.

With certain exceptions, journals covered by some of the more important abstracting services are not indexed. Therefore, this work forms a useful supplement to the works of reference published by these bodies and becomes, itself, a necessary adjunct to the library. No praise is needed for the care taken in the preparation of this work now so well known and so much appreciated. The one criticism that many will make is that, like the majority of abstracting and indexing periodicals, it makes use of the alphabetical system of arrangement: a system that scatters, without reason, information on similar subjects, prevents the possibility of incorporating the index as part of a comprehensive index to scientific and technical information and hinders collaboration between the many agencies engaged in this important work of making information available. In the realm of science and technology alone, there are some three hundred abstracting and indexing journals, four fifths of which are arranged alphabetically by different systems and in different languages. These have to be selected and searched separately, volume by volume, and part by part to find what has been recorded about any particular subject, thus multiplying the labour of every inquiry.

When we consider the number of periodicals it scrutinizes and the aggregate of references included, the volume under review represents a great deal of patient labour. What the compilers of most of these works of reference do not consider is the fact their own particular volume contains only a fraction, in this case one twentieth, of the yearly total output of scientific and technical articles, or, say, one thousandth of the references to useful articles published in the last fifty years, and that, necessarily, serious readers must use other works of reference as well. It is important to study how to make each index the most efficient contribution to a comprehensive index to knowledge, in which all the references to any particular topic come together, no matter when or where they were published.

Such an index can, and will, be achieved by the co-operation of indexing agencies. Since its foun-

dation in 1928, the British Society for International Bibliography has worked to secure such collaboration. A National Committee of Representatives of Abstracting and Indexing Services has now been formed by the Society. This committee will investigate and solve the problems involved in indexing every useful article in the world's output of scientific and technical literature, and the associated services will work in free co-operation to produce a comprehensive index. In order that a standard system of indexing may be made available, the British Standards Institution has arranged to publish the fourth edition of Universal Decimal Classification as a British standard. In accordance with the practice of that Institution, each section of the classification will be produced in collaboration with institutions, societies and individuals specially interested, so that the classification will have the approval of expert opinion. The Library Association is represented on the Publication Committee and will give its valuable aid to this great work. Thus there is, at last, good hope that a comprehensive index to knowledge will be achieved and in the most efficient form.

THERMODYNAMICS AND CHEMISTRY

(1) Thermodynamics and Chemistry
By Prof. F. H. Macdougall. Third edition. Pp. ix+491. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

(2) Thermodynamics
For Chemical Engineers. By Prof. Harold C. Weber. Pp. vii+264. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 19*s*. 6*d*. net.

(1) PROF. F. H. MACDOUGALL'S book was recognized in its two previous editions as particularly suited to the needs of students of chemistry, and in the new edition, which has been extensively revised since the appearance of the second edition in 1926, this feature is again maintained.

Apart from minor but useful changes in various parts of the text, the main alterations comprise a much more detailed treatment of fugacity and activity and of the modern theory of strong electrolytes than was contained in previous editions. The last chapter contains a brief but clear account of the methods of calculating thermodynamic functions by statistical methods, and this should serve admirably as an introduction to the larger works on this subject. Examples are given at the ends of the chapters but unfortunately no answers are provided, which seriously diminishes their utility to both students and teachers. As in previous editions, an appreciable part of the book is concerned with phase rule diagrams, and although this provides a welcome break for the student by leading him through easy paths before taking him into the more difficult part of the book which follows, it is doubtful whether this matter is not better dealt with in a separate treatise.

The whole book is carefully written and the standard is high; many rather obscure points which are either not mentioned at all in other works or are not sufficiently explained are here clearly elucidated. As is to be expected, particular emphasis is laid on electrochemistry, since this has contributed so largely to modern research in the fields with which the book deals. Every advanced student of chemistry could read this book with profit.

(2) Prof. H. C. Weber's book strikes a new note in the literature of thermodynamics. The engineer has long made use of the thermodynamic functions but is probably not very familiar with the chemical applications of the subject, and although the chemist has very recently become aware of the immense utility of thermodynamics, he has usually very little knowledge of those parts of the subject which do not deal with systems in equilibrium of the type which he aims at setting up in the laboratory. Such subjects as the flow of fluid, refrigeration, the various types of power-cycles, and the thermodynamics of steam and internal combustion engines, are outside the scope of books devoted to the chemical aspects of thermodynamics. They are, however, vitally important to the chemical engineer.

The present book attempts to correlate these two branches of the subject. It deals with the engineering aspects in a way calculated to attract and inform the chemist, and with the chemical aspects in a form which the engineer would do well to assimilate. In the second field, there are chapters on fugacity and activity, equilibrium constants, partial molal quantities, electrochemistry, and the so-called third law. The book thus lays the foundations of a treatment of thermodynamics which is particularly suited to the chemical engineer. There are good numerical examples at the ends of the chapters but, as is so often the case with American books, no answers are provided.

J. R. PARTINGTON.

FOOD FROM PRODUCER TO CONSUMER

Britain's Food Supplies in Peace and War
A Survey prepared for the Fabian Society by Charles Smith. Pp. x+290. (London: George Routledge and Sons, Ltd., 1940.) 10*s.* 6*d.* net.

THIS book opens with a brief and sound chapter on the need for a food policy. It includes, in separate chapters, data on bread, milk and milk products, eggs, meat, bacon, fish, vegetables and fruit, tea and sugar. The foundation for a food policy must be requirements for health, and the general standard used is the amount required when consumption in lower income groups in Orr's "Food, Health and Income" is raised to that of Group IV, higher groups continuing as before. For milk, the higher scale recommended by the Ministry of Health Advisory Committee on Nutrition is used. These detailed discussions are followed by general chapters on agriculture, distribution, food in war and the improvement of nutrition.

The main interest of the book lies, not on the strictly nutritional side, but in its presentation in concise and clear form of valuable data on the marketing and distribution of food, the structure of food prices and the way in which both production and consumption of essential commodities are controlled by a relatively small number of powerful combines of processing and distributing firms. The extent to which this is the case may surprise the general reader. It is good that he should understand the position. Government attempts at interference have, in some cases at least, strengthened this control.

There is not much reason to expect an important rise in consumption of bread if the price is reduced; rather will money be set free for buying other foodstuffs. That is true and might have been put even more strongly. Among the poor, a rise in the price of bread means more consumption, not less, because bread is the basic energy food against which all others compete. The production of bread is dominated by the millers, chiefly the Millers' Mutual Association which mills 80 per cent of the flour, and the co-operative societies. The price of bread is fixed, within a prescribed scale, by local bakers' associations which, by an extraordinary system of threats of stoppage of flour supplies, arranged apparently with the millers, prevent bakers from selling below that level. The efficiency of the baking industry is often low, and the cost of distribution is extravagantly high. The controlling part played in other industries by groups of processing and distributing firms is equally interesting.

The book is open to criticism on several heads. The text is marred by minor peculiarities, and inconsistencies in the figures quoted occur without comment. It is more disappointing that the author has so often failed to trace the implications of his policy of expansion of production beyond the first stages. For example, when he envisages an expansion of milk production to meet his stated liquid milk requirements and at the same time to maintain a butter and cheese industry in competition with that of New Zealand, he does not appear to appreciate the difficulty under which the dairy industry in Great Britain, with its intensive feeding practice, would compete with that of New Zealand with its extensive system of pasturage. He does not make clear whether he wishes supplies of dairy products from sources outside the Empire to be eliminated. If so, this alone would mean doubling our milk production, and, if we also competed with the Empire on the butter and cheese markets, doubling (with substantial improvements in average yield per cow) or possibly trebling our cow population. In such a case, is he prepared to see the beef market supplied only or chiefly with home-fed cow beef and veal, or would he eliminate imported chilled meat? Expansion of home production of dairy products raises both primary and subsidiary problems of disposal and world price elsewhere. A country which imports two thirds of its food cannot solve the very numerous problems of price and purchasing power which arise by adjustment within its own borders alone. He touches on the problem of the low standard of living in India and the West Indies when he discusses tea and sugar, but neglects it in connexion with the supply of oil-seed concentrates for cattle. To discuss such problems would, however, possibly require a second volume.

In any event, there are plenty of problems within the country which call for solution. It can scarcely be questioned that the country cannot afford the very expensive services of the combines which organize so much of our food supply. The proposals made here cannot be considered as solving more than a small part of the problems and, in particular, not the main problem of adjustment of the earnings of different productive industries, including agriculture, so that they are balanced against each other. But they do direct attention to a number of important points at which economies

could be made, even without tackling the bigger problems. The chief of these is the "socialisation" of processing and distribution. There is little room for argument as to the desirability of control. The question of how much of the possible saving should be passed on to the consumer and how much should revert to the producer raises all the attendant issues already suggested.

NUTRIENT SOLUTION CULTURE OF PLANTS

Soilless Culture Simplified

By Prof. Alex Laurie. (Whittlesey House Garden Series.) Pp. xiii + 201 + 14 plates. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 12*s.* 6*d.*

MUCH interest has been aroused in this subject by virtue of the publicity afforded it by the popular Press and by a number of publications, many of which contain statements and claims which are unwarranted. It is refreshing, therefore, to find that the aim of the author of this book is "to present the actual status of the subject; to disabuse the average person, the enthusiastic gardener or the commercial grower of false notions; and to discuss the real possibilities that the field of chemical plant culture promises".

Prof. Laurie considers that before successful soilless culture can be accomplished, the grower must possess a thorough understanding of cultivation in soil. Accordingly, more than a half of the book is devoted to this latter aspect with chapters headed "The Soil and the Functions of Elements", "Nutrient Deficiency Symptoms of some Horticultural Crops", "Fertilisation of Crops in Soil and the Effect of Overdoses", and "How Plants Grow". Whilst there are many interesting details regarding flower culture within these chapters, their presence means that the title of the book does not correctly describe its contents.

From the point of view of nutrient solution culture, there are sections on the growing of crops in sand, growing of plants in "water", growing of crops in gravel and soilless gardening for the amateur.

The author, who is professor of floriculture in the Ohio State University, is mainly concerned with flower cultivation throughout the book, and the technique of growing carnations, sweet peas and other flowers in sand is described. It is noteworthy that satisfactory cropping has been obtained at Ohio when the fertilizer mixture (a complete fertilizer of the 15–3–15 type plus magnesium sulphate) has been applied *dry* to the surface of the sand bed at regular intervals. Such a method obviates the necessity of making up a nutrient solution and the bed requires water only in between fertilizer applications.

Little space is devoted to growing plants in "water", or "tank culture" as the method which has so fired the public imagination is sometimes called. Prof. Laurie points out that most unjustifiable comparisons have been made between plants grown in tanks of nutrient solution and those grown in soil, and is faithfully fulfilling his mission when he states that "No convincing evidence has yet been presented where on a large scale production in the greenhouse, crops grown side by side, one group in water and the other in soil, differed greatly in yields". For the inquiring amateur full details of this particular method are given, and it is pleasing to note the stress laid upon the need for adequate aeration of the nutrient solution when using this technique.

In the Floriculture Department of Ohio University, the sub-irrigation system involving the periodic flooding and draining of beds of gravel with the nutrient solution has found most favour. Consequently, Prof. Laurie gives authoritative details of the many aspects of this method and specific instructions for the growth of a number of flower crops. It is disappointing that in this section, which is the longest chapter on nutrient solution culture in the book, there is no reference to the growing of vegetable or other food plants. Much useful information is included on the construction and use of equipment including pumps and growing media, the formulæ of a number of nutrient solutions and their use, the testing and control of the *p*H of the solution, and the simple determination of some of the elements present.

The book ends with a chapter on soilless gardening for the amateur, and in bold relief is the author's own conclusion that as a hobby it is an interesting and absorbing subject, but that it is not yet ready for development on a large scale by commercial growers who need to look beyond the novel. That excellent flower crops can be grown in purely inorganic media and solutions is well demonstrated, and as Prof. Laurie points out when dealing with the sub-irrigation method "it should be noted that organic matter—so important when plants are grown in soil—becomes unnecessary because its functions are taken care of automatically, and the nutrients are presented in such form as to be readily available to the plant". If this book assists the reader to view in clearer perspective the role of organic matter in relation to the growth of plants, no mean service will have been performed.

W. G. Templeman.

THE ORMSKIRK POTATO RESEARCH STATION

By Dr. Redcliffe N. Salaman, F.R.S.

FROM the moment of its inception, the National Institute of Agricultural Botany included the potato as one of its major interests. However, before the Institute had time to formulate a constructive programme the Ministry of Agriculture handed to its care an orphan baby of doubtful parentage but intriguing personality, its wart trials at Ormskirk.

Since 1913, John Snell, a servant of the Ministry of Agriculture, had been conducting potato trials at Ormskirk on behalf of the Ministry, and in close co-operation with the local farmers who, alarmed by the rapid spread of wart disease in the north-western counties, had of their own initiative taken steps to test existing and new varieties of potatoes for immunity to wart disease.

These trials were conducted in the highly infected kitchen garden of the Ormskirk Workhouse. In 1917, Sir Lawrence Weaver, controller of supplies in the Food Production Department, learnt of these trials and obtained Ministry support for an extension of their scope, which was urgently needed. In 1918, Miss Johnston, later Mrs. Snell, joined the staff as chief assistant and remained until 1920.

In 1920 the National Institute of Agricultural Botany, which had itself only come into being in January 1919 took over the wart trials, together with the staff, which was enlarged by the accession of Mr. H. Bryan, formerly horticultural inspector to the Ministry of Agriculture, and Miss Whitehead, later Mrs. McDermott.

In 1920, John Snell died and Mrs. Snell retired. Harold Bryan was appointed in his place; Miss Whitehead, who had been Snell's secretary, now became Bryan's chief assistant. These two officers have been responsible, under the Council, for all the work carried on at Ormskirk until this year, when the Ministry decided to close down the field wart tests. Throughout this entire period Mr. Sharrock, the farm foreman, ably seconded them in all their work.

With the susceptibility trials abolished, the National Institute of Agricultural Botany felt that the Station's *raison d'être* at Ormskirk had also ceased. It was realized that work to which the Council attached the highest importance, such as yield and maturity testing, and the selection of promising seedlings, which Ormskirk had made its own, could, in fact, be conducted to greater advantage in an uninfected area nearer to London and Cambridge. The break with Ormskirk, so far from marking the end of the National Institute's potato work, merely records the close of one stage, successfully accomplished, and the opening of another.

Mr. Bryan, who had been ailing for some time, died in August last, and Mrs. McDermott has been temporarily seconded to the Midland Agricultural Station, where her expert knowledge of varieties will find further, and it is to be hoped an extended, usefulness.

Although the Ministry of Agriculture handed over to the National Institute of Agricultural Botany the task of controlling the testing for wart disease, the expenses of which it defrayed, it still retained the exclusive right of registering immune varieties which had been declared distinct by the Synonym Committee. The consequence has been that for twenty years co-operation between the Ministry and the Institute has been of the closest.

The primary work of the Ormskirk Station was to test all established varieties, both English and foreign, for their reaction to wart disease. At the same time opportunity was offered to breeders to send their seedlings to Ormskirk at an early stage so that their susceptibility might be ascertained and those subject to disease in the field eliminated.

The survey of existing varieties immediately brought to light a state of affairs the existence of which had scarcely been realized and the magnitude of which outstripped the wildest imagination. I allude to what has been called, perhaps somewhat clumsily, the problem of synonymity. The meaning of this term is, according to the Oxford English Dictionary, simple enough, namely, "the identity of nature of things having different names". Thus a variety the original name of which is, let us say, 'Golden Splendour', is, when first put on the market, identified by certain clearly recognized characteristics. Its maturity, skin colour, shape, depth of eye, and the like, together create a picture which lends it an identity of its own and ensures its recognition. We soon found that scores of so-called distinct varieties, bearing every sort of name other than "Golden Splendour", but yet identical with the authentic type, were being sold by seedsmen large and small, with but a few notable exceptions throughout the kingdom.

Snell initiated the battle of the synonyms, but died before the work had got thoroughly under way. The National Institute of Agricultural Botany now took over the task and appointed a

committee of experts in 1919 to carry out the work, of which I have been chairman since its inception. The extent of the evil may be gauged by the fact that we found in existence some two hundred synonyms for the variety Up-to-date, and more than ninety each for Abundance and British Queen, whilst many seedsmen's catalogues recorded in glowing terms the superiority of the synonym to the mother stock, with which it had not infrequently shared the same sack in the store-house. In general, the synonym was priced at anything from 20 to 50 per cent or more higher than the original.

To-day the whole nexus of potato synonyms in Great Britain has, practically, been swept away. Much of the credit belongs to the Ormskirk staff; the fight was fierce at first, but such bitterness as there was, was sublimated in the form of newspaper articles and facetious poems addressed to me. Considering its magnitude and universality, the trade must be congratulated on the rapidity with which, when once its eyes were really opened, it rid itself of the evil. If the work at Ormskirk needed any justification, the abolition of potato synonyms alone would be enough, so far-reaching have been its repercussions throughout the whole of the horticultural and agricultural seed trade of Great Britain.

In order to determine the identity of the many hundreds of potato varieties which found their way to Ormskirk, it was necessary to build up as large a collection of existing varieties as possible, a task in which we were greatly assisted by the Scottish Board of Agriculture. This living museum, which contained some sorts which had been in cultivation more than a hundred years, will be preserved. It has been of great service in the training of inspectors to recognize "rogues" in the field.

The reaction to wart disease in the field of the great majority of existing varieties was tested during the first few years of the Station's existence, with the result that Ministry and farmer were henceforth in a position to know which varieties were fit to be grown in infected areas. At once it was evident that a veritable revolution in potato growing was inevitable; so many of the leading favourite varieties were susceptible and hence excluded. Ashleaf Kidney, Epicure, Duke of York, Sharpe's Express, Ninetyfold and Early Regent fell among the earlies, British Queen and Eclipse amongst the second earlies, Up-to-date, President, Magnum Bonum, Fortyfold, King Edward and Northern Star among the lates, to mention but a few of the most widely grown and best-known favourites of the first two decades of this century. Indeed, few really first-class varieties were left in any of the maturity groups.

The discovery of varieties immune to wart disease, first brought to light by Gough in 1908, provided at Ormskirk the basis of a new varietal selection whilst stimulating at the same time breeders in their efforts to fill the yawning gap in the choice of suitable sorts which the official exclusion of susceptible varieties had occasioned in the great wart potato-producing areas of Cheshire, Lancashire and the neighbouring counties.

Foremost among the breeders of new resistant varieties was, and still is, Mr. Donald MacKelvie, who, with others such as Mr. Watson of Messrs. McGill and Smith, Mr. Waight and the late Mr. Lasham of Messrs. Sutton and Sons, have consistently made the fullest use of the Station. Indeed, so great was the output of new seedlings, that it was soon found necessary to institute special seedling susceptibility trials to cope with them. At the same time Mr. J. W. Lesley and myself made use of the Institute's ground and experts, to test the susceptibility of seedlings raised at Barley, Herts, in the course of our research on the genetic inheritance of susceptibility and resistance to wart disease, the results of which were duly published, and gave further guidance to the breeders, many of whom were conversant with the new Mendelian principles.

From the first, Snell, with his magnetic personality, his wide experience and, not least, his gift of the 'winged word', created at Ormskirk an atmosphere hitherto unknown in the 'potato world'. Members of the trade and growers from all parts of the United Kingdom in the autumn flocked to visit Ormskirk and hear Snell, and later Bryan, on whom Snell's mantle fell in rich measure, go round the plots, criticizing and appraising the old and the new. It was realized that with them no sort of interest other than that of the public good and the truth had any weight, and although reputations might be made and lost in one of these visits, during the whole twenty-one years of the Institute's activity there has never been a doubt raised in the mind of any as to the sincerity of the criticism offered, or the integrity of those who uttered them.

Prior to these early Ormskirk days, the potato had been regarded as a useful if rather dull article of food, any interest in which was, in the main, confined to the profits which might accrue in its exploitation. True, the monotony of normal trading might occasionally be broken by some financial boom, the most notorious of which occurred a few years before the Ormskirk activities began. On this occasion an inferior stock of an inferior variety was renamed Eldorado and sold for its weight in gold to a public only too ready to be beguiled. The excitement, the credulity, the folly and the fraud, together with the final dénouement resembled the South Sea Bubble in

miniature. The advent of Snell and his successor Bryan, with their candid, not to say caustic, expression of the naked truth, put an end, it is to be hoped for good, to this kind of activity.

A number of circumstances combined to make the first ten years of the post-War period at Ormskirk notable. The stimulus to scientifically inspired breeding, which the presence of wart disease evoked, no less than the forceful personalities first of Snell and then of Bryan gave producer, trader and consumer, a confidence hitherto undreamt of. The genetic and virus research, which from the start found a welcome, induced an atmosphere of scientific and serious endeavour at the Station, whilst its close association with the Committee of Ormskirk Farmers ensured a due appreciation for the strictly practical exigencies of the producer, without which agricultural research in Great Britain need expect but short shrift. It is not too much to say that Ormskirk in these years became almost a place of pilgrimage, the Mecca of the potato-minded. Nor has it been supplanted in the esteem of its frequenters by any other centre. Until to-day, Ormskirk has remained the focal point of the varied interests concerned; what has happened is that those immediate interests have, so to speak, been saturated, and no fresh revolutionary force, with which Ormskirk might be fitted to deal, has arisen. How this saturation has been achieved must now be told.

Two memorials exist which epitomize two aspects of the work so far described, the strictly practical and the applied scientific: I refer to the Lord Derby and the Snell Memorial Medals. In 1915 Lord Derby gave a Gold Medal to be awarded annually by the Ormskirk Potato Society to the raiser of the potato variety best suited to local conditions. The trials took place on the Institute's ground and the merits of the varieties entered were adjudged by the Ormskirk Potato Society alone. In 1924 the Ormskirk farmers invited the National Institute of Agricultural Botany to cooperate with them. Since that time, the trials have become increasingly exacting, and the scope enlarged to include varieties suitable to all potato-growing areas. In particular, the award is no longer based on superiority of yield alone, but much attention is paid to tolerance to virus infection and palatability. The medal has done much to encourage the production of new varieties. Experience has certainly not justified all the awards, whether made before or since 1924. Indeed, it has been found desirable to extend the trials over a period of two years in order to reach a more reliable decision. In regard to both the potato and the medal, the adage that "All is not gold that glitters" has a special lesson, which it has taken many years of painful experience to acquire.

In 1921 the Council of the National Institute of Agricultural Botany decided to strike a Silver Medal to commemorate the pioneer work of John Snell. It was to be given to those who had done outstanding work whether as raiser, cultivator or scientific worker. The recognition of the latter's services is of interest because it covertly discloses the larger and more catholic attitude which the advent of the National Institute has brought about in this particular branch of horticultural endeavour.

In 1922, Spieckermann and Kotthof in Germany, and Miss Mary Glynne in England, developed the method of growing wart tissue *in vitro* with the view of developing controlled experiments on the infectivity of the wart organism and the susceptibility of potato varieties. These methods were further elaborated at Ormskirk in order to carry out rapid susceptibility tests for the convenience of breeders anxious to curtail the two years official field test which hitherto had been considered necessary. Mrs. McDermott devoted much time and attention to this work, and she and Bryan developed a most efficient and economic system of testing. The value of this work was greatly enhanced by the fact that parallel tests were carried out in every case in the field. This practice allowed of a very close comparison of the findings obtained by both methods. In addition they had the advantage of being able to refer specimens in cases of difficulty to Miss Glynne for histological examination. The work of the last twelve years in which every field test at Ormskirk has been duplicated in the glasshouse, has resulted in the complete calibration of glasshouse and field methods. Indeed, it is this very success of the indoor test as developed at Ormskirk which has been the main factor in inducing the Ministry to abandon the Station.

The testing for susceptibility to wart disease brought other advantages in its train: thus, it provided the opportunity of recording accurate descriptions of the botanical characters of the varieties examined, of which full advantage has been taken.

The activities so far described have all been either the direct, or indirect, results of the wart susceptibility trials, but there has been another and distinct line of research which the National Institute of Agricultural Botany has made its own. I refer to the accurate, statistically controlled, trials for the determination of yield and maturity of new and old potato varieties. The procedure underlying these trials was elaborated at Ormskirk and has become general wherever such trials are carried out. Each year several trials for yield or maturity or both, are carried out at Ormskirk and for many years they have been duplicated at Cambridge, Kirton, or elsewhere. In recent years

the same trials have been repeated in a second year. The results from all these stations and of each year are carefully correlated. The twenty years of the Ormskirk trials, the results of which are to be found in the Institute's *Journal*, allow of a more or less complete comparison of the chief varieties in use to-day both as regards their yield and maturity.

The yield trials of first earlies have been further elaborated so as to estimate the relative capacity of individual varieties to bulk their tubers early. Such information is of considerable use to the producer who can, if he wishes, grow the variety which will render him the biggest crop at the moment when the markets are offering the highest prices.

Research on the control of eelworm under Prof. R. T. Leiper, of the London School of Tropical Medicine, has been pursued for many years at the Station; for this, however, the National Institute of Agricultural Botany has no official responsibility.

The Station at Ormskirk has a record rich in achievement to its credit; if its closure has brought a measure of disappointment to those who have served it so well, they would do well to take heart in the confident knowledge that the advantages which Ormskirk alone could offer have been exploited to the full, and that the lessons there learnt will assuredly bear even richer fruit when transplanted to another soil.

THE SEARCH FOR TRUTH*

By Prof. H. S. Allen, F.R.S.,
University of St. Andrews

Truth

"'WHAT is truth,' said jesting Pilate, and would not stay for an answer."

The word has, of course, acquired more specialized meanings, but the root idea is that there should be *agreement* between some statement or belief and some fact or set of facts.

It is consequently not surprising that science has been called the search for truth, but some qualification is desirable, for religion also may be regarded as the search for truth. The mere fact that we hear of the *conflict* between religion and science suggests that we are concerned with two different spheres of thought and activity.

Logic

Logic has been called the science of reasoning or 'the art of thinking'. It was Aristotle who first elaborated this method of examining the reasoning process, a method which is concerned not so much with matters of fact, the things reasoned about, as with the mental operations that are involved in 'thinking'. If, for example, we say, 'All professors are absent-minded', the pure logician has no occasion to decide whether this statement is in accordance with fact. He is concerned only with the abstract form of this proposition. It is because the hypotheses made by the logician are not necessarily in accordance with the facts of experience that many men of science feel suspicious of the results obtained by these methods of reasoning. Readers of Samuel Butler's allegorical and satirical book "Erewhon" will remember that "the Erewhonians were quick to offer up commensense at the shrine of logic".

Two methods of reasoning employed in logic are frequently mentioned in scientific work. They are 'deduction' and 'induction'. The former is described as the method in which reasoning proceeds from generals to particulars, and it is associated with the Greek philosophers who assumed that starting from certain 'innate' ideas it should be possible to deduce particular consequences. The term 'induction' implies reasoning from particulars to generals, that is to say the requisite materials of knowledge are brought to the mind and then analysed.

In these days, when the experimental method of scientific investigation has brought about such astounding revolutions in the life of man, there are very few who would assert that they adhere solely to the deductive process. Even on this old-time 'conflict' a word of caution may be given. A somewhat cynical American physicist has said: "Facts are messy things, which everyone believes except the man who made the experiments; a theory is clear-cut and definite but no one believes it except the man who put it forward".

The Spirit of Research

The motive power of research—to paraphrase Prof. Whitehead—is a conviction that there is a secret, but "a secret which can be unveiled". Now

*Based on an address to the Mathematical and Physical Society of the University of St. Andrews.

we see in a glass—in a mystery—but then face to face. There is a belief in the mind of every scientific man that there exists a uniformity in Nature, that every occurrence, every phenomenon, "can be correlated with its antecedents in a perfectly definite way", and that the connexion illustrates general principles. The discovery of such correlations is what is meant by the term 'explanation'.

When, however, we turn to the examination of these explanations, we find that the influence of preconceived ideas is often overwhelming. For example, in the days of Galileo the following argument was put forward (to quote Chiaramonti) to rebut the movement of the earth round the sun :

"Angels cause Saturn, Jupiter, and the Sun to move, and the Earth also, if it does move must be moved by angels in its centre. But in that centre of the Earth dwell devils. Therefore devils would have to move the Earth—which is impossible".

Here is an extract from a remarkable letter written by Galileo as a reply to a momentous letter from his old pupil, Castelli, at that time professor at Pisa.*

"Holy Scripture and Nature are both emanations from the Divine Word : the former dictated by the Holy Spirit ; the latter, the executrix of God's commands. Holy Scripture has to be accommodated to the common understanding in many things which differ in reality from the terms used in speaking of them. But Nature, being on the contrary inexorable and immutable, and caring not one jot whether her secret reasons and modes of operation be above or below the capacity of men's understanding : it appears that, as she never transgresses her own laws, those natural effects which the experience of our senses places before our eyes, or which we infer from adequate demonstration, are in no wise to be revoked because of certain passages of Scripture which may be turned and twisted into a thousand different meanings. For Scripture is not bound to such severe laws as those by which Nature is ruled".

It is interesting to compare the spirit of this letter with the attitude of one of the greatest of scientific investigators, Michael Faraday, of whom Tyndall once said that when he opened the door of his oratory, he closed that of his laboratory. The candid historian of science, in the nineteenth century at least, cannot afford to overlook the fact that many of the most prominent investigators in Great Britain were men who were brought up in a devout atmosphere, and of these, several professed their belief in religious principles.

* The correspondence is quoted in full in C. R. Gibson's "Heroes of Science" (Seely, Service and Co., 1913).

Scientific Explanation

It used to be said that "any solution of a physical problem which satisfies *all* the conditions is *the* solution". In these days we should be more cautious in making such a statement. For example, in dealing with the problems of quantum mechanics three different mathematical methods have been applied with success : the method of matrices, the method of quantum algebra as developed by Dirac, and the method of wave mechanics due mainly to Schrödinger. It may be said that these are only mathematical variations ; but before the modern developments had been reached, few would have ventured to prophesy that such far-reaching results could be obtained by such apparently different methods.

There is, however, another objection to the dictum which says that the solution must satisfy *all* the conditions. In general it is difficult, or perhaps impossible, to state what are the exact conditions that must be satisfied. Such a statement would be possible only for an omniscient being. An excellent illustration is the attempt to form an estimate of the age of the earth. I quote from a recent lecture by Prof. W. Peddie.

At the time of Kelvin's calculation of the age of the earth "only one sufficient source of the earth's internal store of heat was known ; and he showed, by conclusive dynamical reasoning, that the resulting age of the earth could not exceed a few hundred millions of years. When the heating effect of the radioactive substances present in the rocks forming the crust of the earth became known, a large extension of the age of the earth, sufficiently large to satisfy geological specialists, became available. At once an outcry arose regarding the supposed failure of Kelvin's dynamical reasoning and conclusions. There was no failure. Sir Oliver Lodge pointed this out, and the clamour at once ceased. Although at the time of Kelvin's work there was not the faintest idea of the possible existence of any other sufficient source of heat than that considered by him, nevertheless, careful as Newton, Kelvin prefixed his calculation by a clear statement of his postulates—If no hitherto unknown source of energy exists. No one knew better than he that assumption lies at the root of all philosophy. His perception of a possibility constituted practically a successful prediction".

Conflicts of Science

Although theology has been called the divine science, it will be convenient for our present purposes to take the more familiar use of the word science and use it to describe our knowledge of the physical or material world. Prof. Whitehead points

out that during the last half century the results of science and the beliefs of religion seem to have come into a position of frank disagreement, but he directs attention to the fact that this is no new thing. "In the first place, there has always been a conflict between religion and science; and in the second place, both religion and science have always been in a state of continual development."

"Science is even more changeable than theology. No man of science could subscribe without qualification to Galileo's beliefs, or to Newton's beliefs, or to all his own scientific beliefs of ten years ago."

"Galileo said that the earth moves and that the sun is fixed; the Inquisition said that the earth is fixed and the sun moves; and Newtonian astronomers, adopting an absolute theory of space, said that both the sun and the earth move. But now we say that any one of these three statements is equally true, provided that you have fixed your sense of 'rest' and 'motion' in the way required by the statement adopted."

Another example may be taken from the theories as to the physical nature of light. "Newton's theory was that a beam of light consists of a stream of very minute particles. . . . Huygen's theory was that light consists of very minute waves of trembling in an all-pervading ether." "To-day there is one large group of phenomena which can be explained only on the wave theory, and another large group which can be explained only on the corpuscular theory. Scientists have to leave it at that, and wait for the future, in the hope of attaining some wider vision which reconciles both." This was written in 1925 not long after Louis de Broglie had introduced those new ideas which have led to the development of wave mechanics. He wrote: "If, then, we boldly assume that waves and corpuscles are always closely associated in Nature, then the motion of any corpuscle must always be associated with the propagation of a wave. . . ." This general theory of the connexion between corpuscles and their associated waves is the foundation on which wave mechanics has been built up.

According to Prof. Niels Bohr, we must employ "complementary" descriptions to account for phenomena on the atomic scale. For example, the corpuscular picture and the wave picture "are certainly complementary, but at the same time, taken strictly incompatible". Each description is an "idealization" permitting us to represent certain aspects of the nature of light, but not all the aspects at the same time.

Shall we adopt the corpuscular picture of light of the wave picture, the quantum theory or the classical theory? In his presidential address to the British Association at Glasgow in 1928, Sir William Bragg suggested that the student of physics might adopt the one hypothesis on Mondays, Wednesdays, and Fridays and the other on Tuesdays, Thursdays, and Saturdays. If we accept Heisenberg's 'principle of indeterminacy' the position is changed. This may perhaps be illustrated by the story of a distinguished Edinburgh professor who met a colleague on the South Bridge and engaged in earnest conversation. At the end he asked "Can you tell me which way I was going when I met you? I forget whether I have had my lunch". The professor of physics who sets out to determine the energy of an electron accurately on Monday morning may soon be at a loss to know whether he is experimenting on Monday or Tuesday; if he wishes to secure *very* great accuracy he may be in a fog as to whether it is 'this year, next year, some time or never'. Energy and time are 'complementary' magnitudes, and when we gain accuracy with respect to the first we lose it with respect to the second.

Science and Religion

If, and when, we are inclined to stress the apparent conflict between religion and science, we should carefully bear in mind that in science itself there has been one outstanding example of a conflict dating back at least to the days of the Greek philosophers. This is the problem of continuity and discontinuity. How is it possible to reconcile the existence of individual elements—atoms, electrons, protons—which are regarded as indivisible and capable of being counted, with our intuitive ideas about time and space which we have regarded as continuous? It is only within the last few years that light has been thrown on this crucial problem by the work of Heisenberg summed up in his Principle of Uncertainty or Indeterminancy, and by that of Bohr expressed by the word 'complementarity'. We are compelled to use in physics conceptions that are essentially contradictory, but we must use them in an appropriate and limited sphere. It should therefore occasion little surprise if in questions of æsthetics, ethics or religion we meet with other conflicts.

In his Gifford Lectures entitled "The Faith of a Moralist", Prof. A. E. Taylor said: "In an age in which scepticism—a languid scepticism—about the 'certainties' of science, not so long apparently the most assured of all 'certainties' has become the favourite intellectual attitude of the 'educated public', our most crying intellectual need, perhaps, is the need of men who will by their robust assertions, arouse us, not from our 'dogmatic', but from our lazily anti-dogmatic 'slumbers'. There was

something heroic about the temper of the 'Mid-Victorian' time, with its cry of

> It fortifies my soul to know
> That though I perish, truth is so."

In our search for truth we shall not succeed if we bandy about catch-words and slogans. Let us beware especially of all -isms, whether political or religious, such terms as socialism, capitalism, communism or Victorian liberalism and conservatism. Even the word 'democracy' is unsatisfying and does not suggest a sufficiently high ideal. It *may* be used as a cloak to conceal a plan for the domination of minority by a majority. Let us get back to the simple and fundamental ideas embodied in some degree in all religions worthy of the name. Freedom is better than slavery, mercy is better than cruelty, righteousness is better than injustice, good is better than evil.

REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS*

By Prof. Enrico Fermi,
Columbia University

THE nuclear reaction produced by neutron bombardment in heavy elements can be conveniently described, according to Bohr, with the assumption that, as soon as the bombarding neutron strikes the nucleus, it is incorporated into the nuclear structure with the formation of the so-called compound nucleus. This is a relatively stable system in the sense that its life-time is very long compared with the frequencies of nuclear particles ; in an absolute sense, however, the life-time is very short, being sometimes of the order of 10^{-12} sec. and sometimes much less.

The ultimate result of the nuclear reaction depends upon the way in which the compound nucleus disintegrates. This mode of further disintegration depends in its turn, for any given nucleus, essentially upon the energy content of the compound nucleus. When the bombarding neutrons are slow, the energy of the compound nucleus is equal to the binding energy of the neutron in the nucleus. Apart from irregular fluctuations from nucleus to nucleus, this binding energy has a general variation with the atomic number and is a maximum for elements of atomic weight about 40, where it is on the average about 9 Mev. From there on it decreases more or less regularly up to the heaviest elements, where it attains an average value of about 5 Mev. If the bombarding neutrons are fast, their kinetic energy must be added to the binding energy to obtain the total excitation energy of the compound nucleus.

The compound nucleus can lose its excitation energy by emission of a particle (neutron, proton, alpha particle or photon) or, in the case of the heaviest elements thorium, protoactinium and uranium, it may disintegrate by fission into two approximately equal parts. Apart from this latter case, the most probable processes for medium weight and heavy elements is the emission of photons and of neutrons. Emission of protons and of alpha particles requires a much greater energy on account of the Gamow potential that the particle must overcome before coming out of the nucleus. Furthermore, in a nucleus containing one hundred or more particles, even when this energy is available, it is unlikely that it should all be concentrated in one single alpha particle or proton in order to give to it sufficient energy to escape from the nucleus. It is much more probable that a neutron would be emitted instead, since a much lower concentration of energy is sufficient in this case.

The relative probability of the emission of a photon or of a neutron depends mainly on the energy. When the energy is barely larger than the binding energy of the neutron, as in the case of bombardment with slow neutrons, a photon is usually emitted. If, instead, the energy of the compound nucleus exceeds by a considerable amount the binding energy of the neutron, as in the case of bombardment with fast neutrons, the emission of a neutron from the compound nucleus becomes the most probable process. Even when the excess of energy is very large, it is improbable that the outcoming neutron carries away all the energy that is available ; indeed one would expect theoretically that the escaping neutron has a small probability of coming out with an energy in excess of 2 Mev. In most cases, therefore, the nucleus remaining after one neutron has been emitted by the compound nucleus will still be in

* A paper presented in a symposium on "Nuclear Physics" held on September 19 during the Bicentennial Conference of the University of Pennsylvania.

an excited state. The emission of one or more photons or, when the residual excitation energy is sufficient, of a second neutron (n, $2n$-reaction) will then occur before the nucleus reaches a stable configuration.

Compound nuclei of the very heaviest elements may also disintegrate by fission. This form of disintegration is made possible by the large amount of energy released by splitting a heavy nucleus into two approximately equal parts. In this respect we may say that all heavy nuclei are unstable. Their practical stability is, however, insured by the fact that the two fission fragments must overcome a practically impassable Gamow barrier for separation. In the case of uranium and thorium, the height of this barrier is no longer so great, and what prevents spontaneous fission is probably the large mass of the fission fragments, which gives a very low penetrability even to a barrier which is not very high. The relatively low excitation due to the arrival of a neutron is sufficient in these cases to excite the compound nucleus into a state above the top of the potential barrier or so near the top that the fission process becomes possible. It should be noticed in this respect that the bare extension of the Gamow mechanism of the potential barrier is probably not the only one that is responsible for the high stability of uranium with respect to the fission process; probably also other factors, as, for example, the low probability that the nucleus should take such a configuration as to make possible the transition into two fragments, play an important part in ensuring this stability.

It follows from this discussion that the most probable types of nuclear reactions in heavy elements under neutron bombardment are the following: (n, γ), produced especially by slow neutrons; (n, $2n$), produced only by very fast neutrons; fission produced only in the heaviest elements by fast and, in one case, also by slow neutrons.

Uranium is a typical example of this behaviour, because in this element all three types of reactions are observed. The (n, γ) reactions was discovered by Hahn and Meitner, who recognized that among the active products produced in uranium by neutron bombardment, one, with a period of 23 minutes, produced by a typical resonance process is carried by an isotope of uranium. The assignment of the atomic weight of this isotope as 239 has been confirmed by direct experiment by Nier, Booth, Dunning and Grosse. U^{239} disintegrates into an isotope of element 93, which is also radioactive with a period of 2·3 days, as proved by the investigation of Abelson and McMillan. When uranium is bombarded with very high energy neutrons, an (n, $2n$)-reaction may take place, the final result of which is the formation of an isotope 237 from the main isotope 238 of uranium. This nuclear reaction has been recently reported by Nishina, and others by McMillan; they found for this isotope a period of 7 days.

The most interesting reaction produced by neutrons in uranium is the fission process which occurs both in the isotope 238 and in the rarer isotope 235. Since the fission process has been already the object of many discussions, I shall limit myself here to the consideration of only one aspect of this phenomenon. The chemical investigation of the radioactive products of fission has proved the existence of a very large number of radio-elements, indicating that the fission can occur in a number of different ways. We are thus led to the conclusion that, after the compound nucleus is formed by adding a neutron to uranium, the actual splitting of the nucleus may lead to different pairs of fragments; each one of them gives rise to a chain of radioactive elements having on the average three or four elements.

It was early recognized that the simple theory of the fission process fails to represent the detailed results, in so far as the splitting does not occur into two equal fragments, but rather into fragments in which one is somewhat lighter and one is somewhat heavier. We have therefore to distinguish between a light and a heavy group of fragments. Presumably a fragment belonging to the light group and a fragment belonging to the heavy group are emitted in the same act. The problem arises now to determine what percentage of the fissions of uranium gives rise to the formation of a certain radioactive product, or rather of a certain radioactive chain. Since it is expected that in every fission a chain belonging to the heavier group and a chain belonging to the lighter group are formed, we would expect a total percentage of 100 for each of the two groups, except for the improbable direct formation of a stable fragment.

Since very little quantitative information is available as to the relative intensities of the various fission products, Anderson, Grosse and I undertook last spring a systematic investigation of this problem. Our purpose was to make a preliminary survey, and the results obtained so far cover most of the known radio-elements of the heavy group. The method used consisted in comparing the intensities of various radioactive products obtained by chemical separations from uranium samples irradiated under standard conditions and for a known length of time with the Columbia cyclotron. A known fraction of each radio-element was separated and brought near a counter; the activity was deduced from the number of counts, corrected in order to take into

account the absorption by the counter walls and the various geometrical factors. We have thus been able to assign the percentage of fissions of most of the chains of reactions belonging to the heavy group. They vary from a minimum of about 0·1 per cent to a maximum somewhat more than 10 per cent. The percentages found so far for the heavy group do not add up to 100, but are about one half of that. Apart from experimental errors, which can be quite considerable in measurements of this kind, this fact is probably due to the incomplete chemical investigation of this group. Probably some more radioactive elements of the heavy group, possibly belonging to the rare earths, have yet to be discovered and analysed.

THE TOTAL SOLAR ECLIPSE OF OCTOBER 1

By Dr. H. Spencer Jones, F.R.S.,
Astronomer Royal

The weather conditions throughout the belt of totality in South Africa at the time of the total eclipse of October 1 were favourable and came up to the highest expectations. Dr. J. Jackson, H.M. Astronomer at the Cape, who made observations at Calvinia, described the eclipse as the best of the four that he had seen, and a perfect one in every way for astronomical observations. The sky was cloudless throughout and there was not even a breeze to shake the instruments. The conditions in the clear dry air of the arid regions of the Lower Karroo had promised to be so good that, before the War, extensive preparations had been made for observations to be made in this area by parties from Great Britain, Holland, the United States and elsewhere. It is unfortunate that the plans were almost completely upset by the War and that at a time when theoretical advance is dependent upon information that the eclipse observations were expected to provide, so favourable an opportunity has in large measure been lost.

The eclipse attracted much popular attention in South Africa. Railway traffic to the eclipse area was very heavy, many special trains being run. The few main roads leading to the belt of totality were congested with many thousands of cars. The limited accommodation in hotels and boarding houses was fully booked, but most of the spectators camped in tents on hills and rising ground where they could see the eclipse to the best advantage. The Prime Minister of the Union, General Smuts, who is a member of the Astronomical Society of South Africa, spared time from his many duties to fly from Pretoria to Cradock to view the eclipse, which he saw under excellent conditions. The most favoured place for watching the eclipse as a spectacle was from the escarpment of the plateau above Van Rhyns Pass, where the high plateau falls away abruptly and without warning to the Namaqua plain 2,300 ft. below. The scene was described as follows in a letter from a correspondent in South Africa :

"We climbed to the top of the Pass, 2,300 feet, and there found on the Plateau a vast encampment: tents, camp fires, hundreds of cars (which grew into thousands), flags, lorries of oranges (for the orange season is in full swing and the scent of blossoms showered into the dusty road as we passed along, for the trees are at all stages), a red cross hut, an A.A. van, even the road scraper with a red flag at each corner had crept up to see the sight. The next morning there were many more cars, and a steady stream, nose to tail, creeping up the Pass, those still on the long road across the plain below lost in a continuous cloud of dust. The heat was grilling. The strata of the mountains is horizontal and resulted in a series, flat topped, even more sheer against the skyline than Table Mountain. It is a savage, dry, primitive place. We looked across the plain, seeing some forty miles distant from our vantage point. A plan, flat as a table, not an acre of cultivation in sight, dun coloured silt it appeared, with markings on the surface, like a picture of the moon without the craters. It was very still, a quite perfect day for all the astronomers wanted to do. A thread of cloud, a whiff, low on the horizon, that was all. After the eclipse had begun we did not notice for some time any appreciable diminution of light and heat. Then, at last, the drama really began. At its height the mountains were inky black, a pale star or two appeared, a great shadow moved stealthily across the plain, a rim of orange light appeared above the horizon and pale yellow above it, and gradually this new dawn rose. We saw the details of the mountains again and the watching thousands. A little wind which had risen, lay down again as the sun progressively emerged. We watched the endless stream of cars passing down the Pass, the dust cloud grew and grew until we could only define the road by the stream of dust, far across the plain and round the farthest mountain."

The darkness at mid-totality is described as not being so great as had been expected, and the light exceeded that of the full moon. The astronomers, however, found the eclipse a darker one than usual. Dr. H. E. Wood, the Union Astronomer, who observed the eclipse at Cradock, described the sky as a dark grey. He states that the planet Mercury, and Antares, the Southern Cross and its pointers and Arcturus could be seen. The corona appeared as a pearly white halo, almost devoid of colour, with long streamers of shimmering silver grey. Three streamers showed on the lower left-hand side of the sun, at least two and a half times the diameter of the sun in length; other long streamers reached upwards. The keen-eyed noticed faint pink prominences, but most of the watchers failed to detect these. Dr. Jackson attributed the general lack of colour to the exceptional clearness of the atmosphere. Totality is stated to have been two seconds shorter than was expected. A national broadcast commentary on the eclipse was made from Cradock by the South African Broadcasting Corporation, English and Afrikaans commentaries being broadcast simultaneously on different wave-lengths.

The party from the Cape Observatory, under the direction of Dr. Jackson, made observations of the Einstein deflection. Two instruments were used. One was a portable equatorial stand, which had been sent out from the Royal Observatory, Greenwich, on which was mounted the 13-in. objective and breech-end of the astrographic refractor of the Cape Observatory. With this instrument, the eclipse field and a specially selected adjacent field were photographed on the same plate; the eclipse plates are to be compared with plates of the same fields obtained three months previously. The eclipse field on this occasion was far from being ideal, but it was expected that exposures of fifteen seconds of the eclipsed sun and five seconds on the adjacent field, with the objective stopped down to an aperture of 7 inches, would show sufficient stars for a reasonably good determination of the displacement. The adjacent field is used to fix the scale of the plates and this scale is then used for the eclipse field to determine the displacement. The advantage of this method is that the stars in the two fields are at about the same distance from the plate centre, so that optical distortion effects, which depend on distance from the plate centre, are eliminated. With this equipment, the three months interval between obtaining the comparison plates and the eclipse was used by Dr. Stoy, of the Cape Observatory, in a photometric programme of observations for direct comparison between photometric standards in the northern and southern skies.

The other instrument was a horizontal camera with a 7-in. photographic lens of 17-ft. focus, fed by a coelostat with a Pyrex mirror. The plates cover a large field and with this instrument the usual procedure of using the distant stars essentially for fixing the scale of the plate and the close stars for determining the Einstein deflection was followed. The complicating factor in this method is that the optical distortions are different for the two sets of stars. The results are not yet available but information has been received from Dr. Jackson that the plates show considerable fogging. As the stars in the eclipse field are faint, the accuracy of measurement will unfortunately be impaired. But even though the observations do not provide any improvement on earlier determinations of the Einstein deflection, the experience gained of the method of photographing two fields on the same plate during the eclipse should be of value. The writer had planned to use this method at Christmas Island in 1922, but cloud prevented any observations being obtained, and the method has not since been tried.

Spectroscopic observations with a moving plate camera were made, also at Calvinia, by Dr. R. O. Redman, of the Radcliffe Observatory, Pretoria, assisted by the Radcliffe Travelling Fellow, Dr. H. Zanstra, of the Netherlands. The moving-plate camera, which was to have been used by the party from the Solar Physics Observatory, Cambridge, was sent out to South Africa for use by the Radcliffe observers. The purpose of the observations was to photograph the transition from the Fraunhofer to the chromospheric spectrum. In order to eliminate disturbing effects caused by the fall in temperature during the progress of the eclipse, the spectograph was set up in a pit 10 ft. deep, in which the temperature changes were small. The cabled information is that Dr. Redman is pleased with the observations obtained, so that some results of value may be expected when the photometry of the spectra has been completed.

Two instruments were used by Dr. C. W. Allen, of the Commonwealth Solar Observatory, Canberra. With a spectrograph designed to give high light-collecting power, the flash and coronal spectra were photographed. A polarigraph was also used, with which the corona was photographed through blue and red filters, in order to determine the degree of polarization in the corona with a view of throwing fresh light on the important question as to the nature of the reflecting particles in the corona. Successful observations, with which Dr. Allen is pleased, were obtained.

Though, therefore, a much reduced programme of astronomical observations was possible, the perfect conditions under which these observations were made give hope that results of importance

will follow and that these will prove of value in the theoretical study of the sun's chromosphere and corona. All these observations have been made possible by grants from the Government Grant Fund, administered by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. The Government of the Union of South Africa also made a contribution towards the expenses of transport of the equipment in South Africa.

In addition to the astronomical observations, Mr. Higgs of the Commonwealth Solar Observatory made radio observations at Victoria West, throughout the eclipse, at intervals of $2\frac{1}{2}$ minutes by means of an automatic recording equipment, to obtain P'–f data, with the aid of a grant from the Radio Research Board of the Australian Council for Scientific and Industrial Research. Radio investigations had also been planned by Dr. B. F. J. Schonland of the Geophysical Institute of the University of the Witwatersrand, but no information about these has yet been received.

OBITUARIES

Sir Robert Hadfield, Bart., F.R.S.

THE death of Sir Robert Hadfield in his eighty-second year on September 30 removes a notable figure from the world of science and of industry. To the outside public he was probably better known than any other metallurgist, while his striking personality and capacity for making friends, together with his activity as a writer and as a correspondent, made his circle of colleagues exceptionally wide.

Robert Abbott Hadfield came of a Derbyshire family long associated with Sheffield. His father, Robert Hadfield, after gaining experience in several branches of the steel industry, set up a works in 1872 for the production of steel castings, at that time a somewhat bold experiment. The business was successful, and the castings, which included hydraulic cylinders of large size to replace the much heavier cast iron, gained gold medals at several international exhibitions. Robert Hadfield died in 1888 when only fifty-seven, after several years of failing health. His son, who had been trained as a chemist and had worked for a time in the firm of Jonas, Meyer and Colver, set up a laboratory in his father's works, and took control of the undertaking when only twenty-four years old. On succeeding his father, the business was converted into a limited company. Steel castings have always remained a speciality of the firm, but even in its early days attention was given to the manufacture of steel projectiles, formerly obtained from France. In time, the undertaking grew to be one of the greatest of armament works, although its products covered a much wider range.

Hadfield's interest in alloy steels arose from reading a publication by the Terre Noire Company on alloys of manganese. In the systematic way which characterized all his work, he studied the effect of progressive additions of manganese on carbon steels. It was known that small additions hardened the steel, but that when the manganese reached about 3 per cent the alloys were so brittle as to be useless. This was confirmed, but the research was carried further, with the surprising result that when 12–13 per cent was reached, an alloy having entirely novel properties was obtained. This new steel was made softer instead of harder by quenching, was non-magnetic, and presented an extraordinary resistance to wear, becoming hard on the surface under abrasion. This, the 'manganese steel' of to-day, was discovered in 1882, a full scientific account of it being given to the Institution of Civil Engineers in 1888. It came into extensive use for railway and tramway crossings, crushing machinery, etc., a well-known application being the protective helmets introduced in the War of 1914–18. The steel is now known to be of the austenitic class, but certain of its properties are still anomalous.

In the same systematic manner, Hadfield examined the influence of silicon, and this research led to the introduction of the low-carbon silicon steels, which proved to have valuable electrical properties, including high resistance and low hysteresis. Their use made a marked saving in the weight of transformers. Later, Hadfield made similar surveys of the alloys of iron with nickel, chromium and tungsten, providing much valuable information but without leading to any alloy of entirely novel properties. He continued his studies of manganese steels over many years and published a number of further papers.

In the early controversies on the hardening of steel, Hadfield took an active part, supporting Prof. Arnold in his insistence on the influence of carbon against those who laid the chief stress on the allotropy of iron, and he lived long enough to see the true elements in both views incorporated into the modern theory.

The direction of a great industrial undertaking, of which he was chairman from 1888 onwards, did not check Hadfield's devotion to the scientific side of metallurgy. He made many friends among scientific men at home and abroad, and was able to interest them in problems concerning metals. Thus he published papers in collaboration with Sir William Barrett, Prof. W. Brown and Sir Ambrose Fleming on the magnetic properties of alloy steels, and with Sir James Dewar and also with Prof. W. J. de Haas on the properties of metals at very low temperatures. He was keenly interested in the history of metallurgy, and besides making a fine collection of old metallurgical books, he examined and described such

typical ancient objects as the famous iron pillar at Delhi, his most exhaustive investigation in this field being that of the alloys of iron prepared by Faraday and preserved at the Royal Institution. This was published in book form in 1931.

Sir Robert Hadfield received many honours. He was knighted in 1908 and received a baronetcy in 1917. He became a fellow of the Royal Society in 1909, and was an honorary member of a great number of technical societies, many of which conferred on him their highest honours. He was president of the Iron and Steel Institute in 1905–7, and of the Faraday Society from 1913 until 1920, and those societies with which he was connected have reason to remember the keen attention which he gave to his duties and his boundless hospitality. Few men have worked so hard and with such system throughout a long life. He was an enlightened employer and a good citizen of Sheffield, where he occupied the position of Master Cutler in 1899–1900, being the second of his family to hold that office. He was a generous benefactor to the University of Sheffield and to other institutions, and gave much kindly encouragement to younger research workers. Shortly after the War of 1914–18 he put forward a scheme for an Empire Development Board, to which he gave much thought and energy. In 1894 he married Frances Bett, daughter of Colonel Samuel M. Wickersham, of Philadelphia. Lady Hadfield, who was created C.B.E. in 1918, worked from 1914 onwards in a hospital which she and her husband founded at Wimereux, and this work was continued during the present War as the Hadfield-Spears Ambulance. C. H. Desch.

Dr. William Bowie

William Bowie, who died on August 28, aged sixty-eight, was best known in Great Britain perhaps as one of the most significant personalities of the International Union of Geodesy and Geophysics. For fourteen years he was the president of the Association of Geodesy, for three he was president of the Union itself, and at the last General Assembly (Washington, 1939) he undertook the duties of the general secretary, who had been recalled to England on the outbreak of war. His influence upon the Union was not confined to his mastery of geodesy or to his eminent work in isostasy, widely known and appreciated as these are. It rested just as much upon an enthusiasm and a strength of purpose which compelled co-operation and stifled the minor jealousies which are apt to clog the wheels of international work. It was a difficult matter to succeed the late Ch. Lallemand who led the Union so brilliantly for fourteen years, but Dr. Bowie did, in fact, add to, rather than diminish, the significance of that post, because his geophysical interests were unusually wide and he could envisage no future in which geodesy did not work hand in glove with geophysics.

The United States Coast and Geodetic Survey has earned the gratitude of all surveyors. It has given us the 'figure of the earth' now used in all international work. It has followed and greatly enlarged upon, the fine record of the Survey of India in developing isostasy. It has shown how geodesy may be subjected to mass production without losing precision. Even its observing towers and lamps came as something refreshing, efficient, simple, and practical. Dr. Bowie was the colleague of, and successor to, John F. Hayford in all these matters, and in our minds is also successor to Alexander Ross Clarke and Everest.

Dr. Bowie entered the U.S. Coast and Geodetic Survey in 1895 and served for forty-two years, of which twenty-eight were as chief of the Division of Geodesy. During the War of 1914–18 he served in the Engineers as a major in the mapping division, and this association with army and with mapping matters lasted until his death. He served on the federal "Board of Surveys and Maps" from 1920 onwards. Probably no one of his generation has more practically and strenuously studied and forwarded a mapping suited to the administrative, economic and industrial development of his country.

In 1919 the American Geophysical Union was founded. Dr. Bowie was its general secretary and, later, president. In his hands it grew in membership from fifty to thirteen hundred, and spread its influence over every territory of the United States. His services to that Union are commemorated by the William Bowie Medal, of which the first award fell, appropriately, to himself.

It would serve small purpose to list the twelve societies over which Bowie had presided or the even longer list of honours and awards which his own country had given to him. He had been honoured also by Belgium, Holland, and Yugoslavia. Edinburgh admitted him, in 1936, to the degree of doctor of laws. More even can be said of him as a strong, able, single-minded man devoted to the advancement of science, and, withal, a singularly likable friend. H. St. J. L. Winterbotham.

Rev. Dr. W. G. Ivens

We regret to record the death of the Rev. Dr. Walter George Ivens, well known as an authority on the languages and ethnology of Melanesia.

After graduating at the University of New Zealand, Ivens joined the Melanesian Mission and laboured as a priest in Melanesia for a period of forty years. During this time he became widely known among scholars for his wide and profound knowledge of the numerous languages of Melanesia, as well as for his intimate acquaintance with their manners, customs, religious beliefs and observances. His "Melanesians of the South-East Solomon Islands" (1927), excellent in many respects, was followed three years later by the far more weighty "The Island Builders of the Pacific" (1930), in which, though it deals with a specialized form of culture, a certain breadth of philosophic outlook provokes reflection.

Dr. Ivens held the degree of Doctor of Letters of the Universities of New Zealand and Melbourne. During 1924–28 he was a research fellow of the University of Melbourne and during 1928–35 travelling secretary of the Melanesian Mission. He was a lecturer at the School of Oriental Studies in the University of London in 1936.

NEWS AND VIEWS

The Right Hon. Neville Chamberlain, M.P., F.R.S.

The death of Mr. Neville Chamberlain on November 9, occurring at so short an interval after his retirement from political life, has afforded him little opportunity for the enjoyment of that leisure that he had earned by his strenuous life as industrialist in the West Indies and in Birmingham, and as a politician and member of His Majesty's Government under several administrations as well as during his own tenure of office as Prime Minister during 1937–May 1940. Mr. Chamberlain entered upon the administration of national affairs at a disadvantage. His work for social betterment and in municipal affairs in Birmingham, which led up to his election as Lord Mayor in 1915, attracted the notice of those in authority in the conduct of national affairs during the War of 1914–18. They called him to a wider field; but his acceptance of office as Minister of National Service in 1917 resulted only in frustrated effort and resignation owing to the fact that he occupied no seat in Parliament. His entry into the House of Commons at the General Election of 1918 determined his activities for the remainder of his life, the greater part of which from that time was passed in office.

Like his father, Joseph Chamberlain, Neville Chamberlain was a striking example of the successful business man to whom the organization of his commercial or industrial interests affords, or did afford, leisure in middle or later life to engage in public affairs—as Bagehot noted, a characteristic peculiar to English public life. In estimating the value of Chamberlain's work as statesman and as a contribution to the welfare of the people of Great Britain, his fame might well rest assured on his tenure of office for five years as Minister of Health under Mr. Baldwin. He passed no fewer than twenty-eight Bills through Parliament in this period—measures dealing with housing, slum clearance on a national scale, old age pensions, rating and valuation, local government reform, and the like. This achievement, however, was overshadowed by subsequent events. As Chancellor of the Exchequer from 1931 onward he took in hand the Herculean task of setting the finances of the country on a sound basis in face of a world-wide economic collapse. When he became Prime Minister in 1937 the financial standing and integrity of Great Britain was as high, or even higher than ever before in the estimation of the world.

The tragedies of the three years 1937–40 need no recapitulation. The death knell of the League of Nations as a political force had already sounded when Mr. Chamberlain accepted office as Prime Minister, and he turned to the policy of 'appeasement' and the formation of a 'peace front'. The policy achieved its greatest success with Mr. Chamberlain's almost superhuman effort at Munich which was "to secure peace in our time"—and it was its greatest failure. The cynical sale of Russia's influence to the highest bidder destroyed the possibility of a peace front in eastern Europe; the tragedy of Czechoslovakia and the treacherous onslaught on Poland showed the futility of faith in the promises of the dictators. Notwithstanding the criticisms of Chamberlain's achievement at Munich and the disappointment at his misunderstanding of his opponents' true character, it is safe to predict that from this very failure his reputation as a great representative of all that is best in the English people will grow. As is shown by his record in peace-time, he was a practical idealist with an inextinguishable enthusiasm for the betterment of the human lot and a belief in the fundamental integrity of the individual. It is to such men, and not to the doctrinaire, that we must now look for the practical measures which will bring about the reconstruction of a post-War world; and in this the example of Chamberlain's work of social reform will endure. If he failed to secure peace it was because, being an honest and upright man, untrained in the methods of gangster diplomacy, he failed to appreciate the possibilities of treachery in those who use promises and solemn undertakings as counters to secure ignoble ends.

Although the career of Mr. Neville Chamberlain was political, a considerable amount of his time was devoted to amateur natural history. In his younger days, about 1902, he was a keen member of the old Birmingham Entomological Society, and he used to exhibit at its meetings which were held at Avebury House, Newall Street. He was usually in company with his uncle, Alderman George Kendrick, a well-known local entomologist, and Mr. Chamberlain made a special study of the camouflage of pug moths which he collected from the railings of his father's house, "Highbury", at Moseley. He also made extensive collections of the Geometræ. In later years in London he maintained this interest in entomology and recorded the wood-leopard moth in the garden in Downing Street; but then his interests were more devoted to ornithology and he contributed to the annual report on the bird sanctuaries in the Royal parks, published by H.M. Stationery Office, 1936, noting pied wagtails in St. James's Park and large flocks of redwings during the frost. St. James's Park was his special venue, where his early morning walks during his office as war-time premier were reminiscent of the walks of the late Lord Grey of Fallodon during the War of 1914–18. In addition to the pied wagtail and the redwing, Mr. Chamberlain recorded the lesser black-backed gull, the carrion-crow, the swift, the kestrel, the grey wagtail and the wheatear in St. James's Park. He also recorded a melanic form of pied wagtail in Downing Street, and in the garden common to No. 10 and No. 11 he maintained a bird table and bird-boxes, inducing the blue tit to nest there, and blackbirds and song thrushes to become resident. He also shared Lord Grey's fondness for fly-fishing.

Earthquake in Rumania

Early on the morning of November 10, a very intense earthquake shook nearly all Rumania, and was also felt in Sofia, Belgrade, and many other places in the Balkan States. It will be recalled that a strong double earthquake was felt for about 30 seconds in Bucharest on October 22 (see Nature, Nov. 9, p. 615), and that this was at the time thought to be the precursor of a stronger shock. Evidently the supposition was correct, though the time interval between the premonitory shock and the now much stronger one was greater than anticipated.

Although small earthquakes and tremors are by no means unknown in Rumania, that country has in the past not been so severely hit by these catastrophes as other Balkan States such as Greece. The shock of October 22 may have had its epicentre near Barlag, though some damage was done in Bucharest, the capital. The present shock again severely affected the capital, where many famous buildings are reported damaged and destroyed, and where the casualties are probably high. From other towns, including some in the region of the oil wells, damage and casualties are also reported. A further earthquake, said to have caused enormous damage and many casualties, included among whom were rescue parties working amid the debris of the first earthquake, occurred early on November 11.

Youth Service Corps

In a circular to local authorities (H.M. Stationery Office, 2*d.*) the Board of Education sets out a new scheme for the physical training of youth between the ages of fourteen and twenty. The ultimate aim is not the creation of a new movement but the co-ordination of already organized local units, the resulting corps to be run by the young people themselves. Arrangements have been made with the War Office for the gradual release, so far as military requirements allow, of experienced leaders, organizers and certain physical training instructors. All available premises, such as gymnasia, halls, playing-fields, sports grounds and swimming-baths, will be utilized. The supply of suitable clothing is also considered. Suggestions concerning methods of appealing to the youth of the country are also given; these include appeals to those leaving school, old scholars' associations, evening institutes, youth rallies, the "Fitness for Service" scheme, contact with industrial workers, and general publicity. A badge scheme is also outlined.

The Suez Canal

Nature seventy-one years ago (1, 81; 1869) recorded the opening of the Suez Canal "in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished *savants* invited from the East and from the West". The question of the canal has, however, dated back to a much earlier period. Tradition has it that Alexander first discussed its feasibility, but decided against it on account of the difficulty of the mouth of the canal becoming silted up. After other projects, the first Napoleon revived the idea, and from that time the question of a ship canal became a standing topic. With progress in the sciences, especially those of immediate bearing such as geology and engineering, the possibility became more and more convincing, and culminated in the opening on November 17, 1869, the result of one of the greatest of modern engineering feats. It may be well to think of the difficulties faced by science at the time, which in the "pre-scientific age rendered man's contests against the works of the winds and sea perfectly hopeless" but with the aid of science were now conquered.

Greece

The Greek Mathematical Society has sent an appeal for help and sympathy to the whole brotherhood of mathematicians, in the name of "the birthplace of mathematics, the country of Pythagoras, Plato, Euclid, Archimedes and Apollonius". Not only the mathematician, but also every scholar and scientific man should answer to the call. Of those five great men it so happens that one was born in Sidon and another in Damascus, another in Perga, and the greatest of all in Sicily; nevertheless Greece has a right to claim and speak for them all. In her golden age they contributed to her glory, and her language has preserved their teaching for the world. Greece herself has had five distracted centuries since Byzantium fell, and her fugitive scholars brought the Renaissance into Europe. Even the last hundred years, since Byron and his Philhellenes fought for her independence, have been hard and troubled times. But in the last few years order has reigned, and much has been done. The University of Athens has quickly become a flourishing institution. Her laboratories are busy, her own library and other lesser libraries are rich, the museums there and elsewhere are well kept and beautiful. We may think not only of what she did two thousand years ago, but also honestly admire her part in the art and science and letters of to-day. Great Britain is again on Greece's side, and the readers of Nature not least of all.

The Next Total Solar Eclipse

With the October 1 total eclipse of the sun now past (see p. 642 of this issue), and observations in South America at least ruined by clouds, some astronomers will now be looking forward to their next chance. This will come on September 21, 1941. Plans are uncertain at present, because the best place from which to see it will be on the coast of China, between Foochow and Wenchow, as well as farther inland, at Hankow and Nanchang. Whether certain foreign astronomers will be able to set up their instruments there by next September is perhaps rather questionable. The tip of the moon's shadow next September 21 will first touch earth at sunrise in Russia near Astrakhan. Then it will cross the Caspian Sea, the Aral Sea, Turkestan, Tibet and China. After that it will pass across the western Pacific Ocean, including the American island of Guam. Here the sun will be blacked out for about two and a half minutes, or fifty seconds less than in China, but this would still give time for many valuable observations.

The Earl of Rosse (1840-1908)

Among the noblemen who during the nineteenth century devoted themselves to scientific pursuits, few were better known than the third and fourth Earls of Rosse. The former constructed the famous reflecting telescope at Birr Castle, King's Co., Ireland, and from 1848 until 1854 was president of the Royal Society, while the latter carried on his father's observations on nebulæ, made investigations on the heat radiated from the moon and held important offices in Ireland. Sir Laurence Parsons, the fourth Earl, was born at Birr Castle on November 17, a century ago, and was the eldest of six sons, of whom the youngest was Sir Charles Parsons, of steam turbine fame. Educated partly at home, he graduated from Trinity College, Dublin, at the age of twenty-four, and three years later, on his father's death, succeeded to the title and estates. From early manhood he took a part in public life, and in 1885 was made chancellor of the University of Dublin; in 1887 he became president of the Royal Dublin Society and in 1895 president of the Royal Irish Academy. He was a fellow of the Royal Society and of the Royal Astronomical Society from 1867.

Among engineers Lord Rosse was known for the unswerving support he gave his brother in the difficult pioneering work on the steam turbine, and was a director of the Marine Steam Turbine Company formed in 1894 to construct the historic *Turbinia*. In Mr. Rollo Appleyard's biography of Sir Charles Parsons are many letters to Lord Rosse relating to the steam turbine, which he lived to see adopted for the *Dreadnought*, the *Mauretania* and *Lusitania*. A man of wide interests, a generous employer and a philanthropist, Lord Rosse died at Birr Castle on August 30, 1908. By his will he left a sum of money for the upkeep of the telescopes and instruments made famous by his father.

Dr. James Finlayson

Dr. James Finlayson, an eminent Glasgow physician and medical historian, was born on November 22, 1840, at Glasgow, where he received his medical education and qualified in 1867 with a thesis on "The value of quantitative methods of investigation in medicine and the allied sciences". In 1871 he was elected fellow of the Faculty of Physicians and Surgeons of Glasgow and a few years later its honorary librarian, in which capacity he served the faculty for more than a quarter of a century. In 1875 he was appointed physician to the Glasgow Western Infirmary, where he taught medicine until his death, and from 1883 until 1898 he was physician to the Glasgow Royal Hospital for Sick Children. In 1899 he was elected vice-president and in 1900 president of the Faculty of Physicians and Surgeons, and made an honorary LL.D. of the University of Glasgow. His writings covered the whole range of medicine, but his chief work was his "Clinical Manual for the Study of Medical Cases", of which the first edition appeared in 1878 and the fourth and posthumous edition in 1926. He also wrote the chapter in Keating's Cyclopædia on the diagnosis of children's diseases (1889). He took a lively interest in the history of medicine, and from 1892 to 1895 gave a number of bibliographical demonstrations on Hippocrates, Galen, Celsus, Herophilus and Erasistratus. His most important historical publications were the "Account of the Life and Works of Maister Peter Lowe (1889), the founder of the Faculty of Physicians and Surgeons, Glasgow", and the "Account of the Life and Works of Dr. Roland Watt, author of the Bibliotheca Britannica" (1897). He died suddenly on October 9, 1906.

Morbidity and Death-Rates in Great Britain

The issue of the *Lancet* of November 2 contains an instructive article on this subject by Dr. Percy Stocks, medical statistical officer to the General Register Office, who shows that the standardized death-rate from all causes was not so large in the March quarter of 1940 as in the severe winter quarter of 1929, but it was above that of any intervening quarter. Very high rates were returned in several large towns. The adjusted death-rate in those great towns which served as reception areas, after a temporary increase probably due to influx of many infirm persons, has fallen relatively to that in Greater London and the evacuation towns. During the autumn and winter when schools were closed in evacuation areas and partly closed in neutral areas, the diphtheria notification indices among children in London and the evacuation towns were only half those of a previous year compared with a decline of 17 per cent in the reception and 22 per cent in the neutral towns, but there was no equivalent reduction in the death-rate. In the June quarter when schools reopened the contrast between evacuation and reception towns ceased.

The scarlet fever notification index during the March quarter in the evacuation towns was less than half that of a previous year, compared with a fall of 31 per cent in the reception towns, and this position did not change when the schools reopened in the June quarter. Measles and whooping-cough deaths during the March and June quarters amounted in the evacuation towns as well as in Greater London to a very small fraction of the numbers in the previous years; the reception towns showed little change, and the neutral towns a moderate fall. The measles notification rate per 1,000 children under 15 in the evacuation towns was only 6 in the March quarter, rising to 25 in the June quarter when the schools reopened, compared with 59 and 48 respectively in the reception towns. The whooping-cough notification rate was half as great in the evacuation towns as in the reception towns in both quarters, the neutral group being intermediate. The cerebrospinal fever notification rate at all ages and the death-rate at ages over 15 during the March quarter were higher in the reception towns than elsewhere, but this was not maintained in the June quarter.

Scientific Training and Administration

At a meeting of the Institute of Fuel held on October 17, an address was delivered by Mr. W. H. Selvey, who has been acting president during the

absence in the United States of Colonel J. H. M. Creenly. Among other matters, Mr. Selvey spoke of scientific invention and its application to the life of a country. He said that it is generally twenty years or even longer before scientific knowledge produces practical applications which enter into the common life of the country. We should consider what kind of men should ultimately compose that small inner coterie, existing in every country, which has the power and responsibility of putting great forces into action. Those men to-day are primarily educated in what is called the 'humanities', a form of education which leads to an astute knowledge of how to govern men through their lesser qualities, sometimes even their weaknesses. The growing reaction against this form of education of some of the finest minds has led, not to a change in their education but in replacing them by representatives of the 'people', mostly great-hearted men, but possessing this in common with colleagues of the former type, that in discussions of any grave difficulty they can always brush aside questions which demand answers by saying that they are purely technical.

It is a surprising state of affairs that, in a world which is fast becoming wholly technical, those possessing power and responsibility seem almost to boast of their ignorance of technical questions. There are countries, however, where those in real power are technically trained as a basis for their future activities, educated to a certain extent in the scholastic field of knowledge, but totally devoid of morals when acting as functionaries of the State. The jibe that technologists do not make successful administrators will, so long as government turns on the management of men by their foibles, always contain an element of truth. The matter must be dealt with at an earlier stage. It is not more difficult to distinguish between young technologists than among young classical graduates, which men are likely to develop into administrators. There is a growing consciousness that something must be changed before it is safe to put further powers evolved by scientific workers and technologists in the hands of those governing the political fortunes of the State. But men of science and technologists must go on; therefore they must themselves delve deeper into those questions which they, in turn, have been equally amiss in shelving as political, moral, ethical and religious.

British Empire Naturalists' Association

Since the suspension of *Country-Side*, the quarterly journal of the British Empire Naturalists' Association, due to the War and paper shortage, its duplicated quarterly *Branch News* has considerably extended its circulation and has become the official war-time organ of the Association under the editorship of the organizing secretary, Mr. Leslie Beckett, and it is still produced and issued from 22 South Drive, Ruislip, Middlesex. The new October issue outlines a scheme by which this duplicated news-sheet will be circulated to all who desire it in return for four stamped addressed envelopes a year. This will reduce the heavy clerical work as well as the expense. The current sixteenth issue records the rare crimson variety of *Erica cinerea* and *Orchis purpurea* in mid-Kent, the black redstart successfully nesting in London near Westminster Abbey and singing in Piccadilly, elephant hawk moth larvæ feeding on orange balsam in Surrey, an adult male Montague's harrier, green-, wood- and curlew-sandpipers, ruff, little stint, garganey, greenshank, pochard and shoveller among the autumn passage birds at Slough Sewage Farm, Bucks, while a summary of the British Empire Naturalists' Association's summer field meeting held in the Ludlow district of Shropshire notes the pied flycatcher and the sandpiper found nesting and hundreds of plants of *Astrantia major* found in full bloom. It is hoped to arrange the usual midsummer meeting in 1941. A request is made to collect certain herbs to aid botanical drug importers faced with the stoppage of imported Continental supplies; but these will be plants abundant everywhere and not likely to injure the flora of the countryside. Although many of the branches are finding difficulties from air raids and war-time duties of members hindering their meetings, activity is still being maintained and meetings held by the branches for London, Middlesex, Merseyside, Norfolk, mid-Kent, south Devon, Derbyshire and north Lancashire.

Traditional Culture and Individuality in Britain

A study of "The Celtic West" by Prof. H. J. Fleure (*J. Roy. Soc. Arts*, **88**, Oct. 4, 1940) will add strength to the arguments of those who urge that the lowering of national barriers in the interests of co-operation in international affairs should not be allowed to obliterate those cultural differences and diversity of ideas by which intellectual advancement largely has been promoted in the past. "The value of personality," says Prof. Fleure, "is now felt to be the essential for which we are fighting, and, in this respect, we can learn a good deal from the Celtic west." He points out, indeed, that although "the Celtic race" is a term both unscientific and in point of historic fact incorrect, the tradition of the Celtic west conserves a pattern in which are woven strands of many ages, some perhaps 4,000 years old. The purpose of his argument is to show that this traditional pattern has contributed to the cultural life of Great Britain something which is lacking in the English-speaking regions of the country.

In England there has been a failure to afford the skill of the rural worker opportunities to adapt itself to modern conditions—a verdict which will be endorsed by all who have watched the decay of rural arts and crafts in our country districts. In the Celtic west, however, something of the old life of the peasantry survives. It is manifested not merely in adaptability to a variety of manual tasks, but also intellectually in an abiding interest in the deeper and more spiritual sides of life—"a peasant heritage that is even now struggling to escape destruction". It is in this aspect in particular that Prof. Fleure finds the lesson of the culture

of Wales, which he points out has afforded the people opportunities for the expression of their individuality in the fields of oratory, poetry and song. Through these our common British life has gained vastly from the spring of an ancient cultural tradition. By this tradition even the miners of South Wales have been preserved from the worst evils of industrialism. How to keep this contribution to our common life from submergence, Prof. Fleure concludes, is a problem worthy of much study.

Aerial Ropeway in Central Sweden

An aerial ropeway of exceptional length is being built in Central Sweden for the purpose of conveying limestone from quarries to a new cement factory. From a description given in *Engineering* of October 18, we learn that the ropeway is 28 miles in length, and will be capable of transporting 700,000 tons of material per annum. The running, filling and emptying of the 550 skips used is carried out entirely automatically. The construction work is now well advanced; the supporting towers have been erected along the entire route, and the work of placing the cable in position has now begun. Several difficult problems have been successfully solved. One of these was the best way to convey the ropeway across two wide waterways. In one case this has necessitated the suspension of the ropeway at a height of 22 metres to enable ships to pass freely underneath. In addition to carrying the line across a lake, concrete towers, 147 ft. 7 in. in height, have had to be built in the water. It is anticipated that the installation will be completed by the end of the present year.

Mental Hygiene of Old Age

In a recent paper (*Mental Hygiene*, 24, 734; 1940) Dr. Nolan D. C. Lewis, director of the New York State Psychiatric Institute and Hospital, New York City, makes the following recommendations for avoiding or relieving the mental troubles of old age. In the first place, the senile individual should be used economically by arrangement of changes of work and frequent rest periods. The individual should be relieved so far as possible from worry, mental strain, anxiety and feelings of financial insecurity. With the gradually devitalizing processes in mind, special care should be taken to avoid physical discomforts, vitiated air, infections and over-eating. The senile patient should also be protected from injuries, as they may produce or increase a tendency to hypochondria. It is important to avoid any heavy burden on the sense organs through which exhaustion of the central nervous system may occur. The younger and more able associates of the senile individual should make allowances for the occasional lack of acuity in dealing with situations which require fine discrimination and tact. Tolerance and understanding should be used with the aged person who shows a marked egoism together with uneasiness, restlessness and a tendency to harp on his difficulties.

Folk-lore of the U.S.S.R.

The Academy of Sciences of the U.S.S.R. is to issue a new work entitled "Soviet Folk-lore", into the compilation of which has gone much effort on the part of many expeditions to different parts of the Soviet Union. An expedition sent out to the Stalingrad Province by the University of Leningrad has collected much interesting material relating to the folk-lore of the Don Cossacks. In the villages and farmsteads of that province the expedition recorded 110 folk-tales, 550 Cossack songs, as well as numerous proverbs and legends. Among the songs are some about Stepan Razin, Yermak, Peter the Great and the War of 1812. This expedition has also collected interesting material relating to the new Soviet folk-lore of the Don Cossacks. Records were made of songs and tales on the subjects of Stalin, Voroshilov, Budenny, the Civil War and the collective farm.

Adams Prize: Subject for 1941–42

The Adams Prize, which is open to the competition of all persons, including women, who have at any time been admitted to a degree in the University of Cambridge, is awarded for an essay, the subject proposed for the period 1941–42 being "The theory of the elementary physical particles and their interactions". The essay may contain a discussion of the properties of some or all of the elementary physical particles and of their associated fields; the theory of cosmic rays and the structure of nuclei come under the scope of the subject. The value of the Prize is about £288, but may be increased, when it seems desirable to the adjudicators, on occasions when the prize is divided. Provision is also made for the award of extra Adams Prizes in suitable cases. The essays must be sent to the Registrary of the University on or before December 31, 1942.

Comet Okabayasi

Harvard College Observatory Card 539 reports the discovery of a comet of magnitude 11 on October 4 by Okabayasi. *Card* 540 gives the following elements and orbit computed by Miss Scott at Berkeley:

$$\begin{array}{ll} T & 1940\ \text{August}\ 11{\cdot}979 \\ \omega & 320^\circ\ 40' \\ \Omega & 125\quad 59 \\ i & 131\quad 25 \\ q & 0{\cdot}9730 \end{array} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1940$$

Announcements

Mr. Francis Druce has resigned the honorary treasurership of the Linnean Society after serving for nearly ten years. On November 7 the Society elected as his successor Major F. C. Stern.

The Rockefeller Foundation, the Carnegie Corporation and other United States bodies have guaranteed £125,000 to take to America a hundred leading scholars who have fled from Germany.

Errata. In the article on "Early Explorers of Southern South America from the United States" in Nature of August 17, p. 238, line 5, for "Stongington" read "Stonington", and line 8 for "Jerimiah N. Reynolds" read "Jeremiah N. Reynolds".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

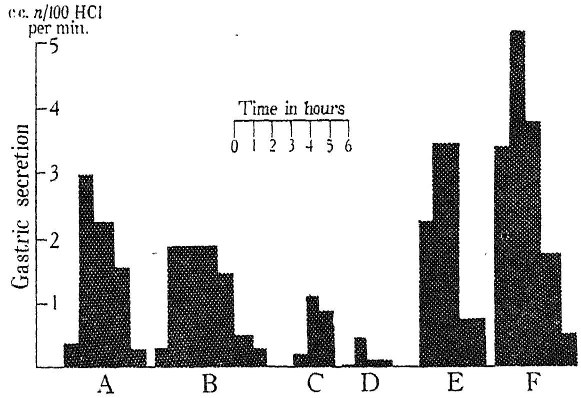
IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Activity of Carbonic Anhydrase in Relation to Gastric Secretion

IT has been shown recently by Davenport[1] that the gastric mucosa of mammals is very rich in carbonic anhydrase, which seems to be localized in the parietal cells. According to Davenport, this observation together with some other considerations suggested the possibility that carbonic anhydrase takes part in the secretion of hydrochloric acid. According to this view, carbonic anhydrase catalyses the hydration of carbon dioxide to carbonic acid, which ionizes to H^+ and HCO_3^- ions. The H^+ ions are concentrated and secreted while HCO_3^- ions pass into the blood to replace the chloride ions which accompany hydrogen ions. "If carbonic anhydrase in the gastric mucosa were inhibited the chain of reactions would be interrupted, and the mucosa would be unable to secrete acid"[2]. This clearly suggests that the validity of this theory of gastric secretion can easily be tested by means of a suitable inhibitor of carbonic anhydrase.

It is obvious that substances such as potassium cyanide, hydrogen sulphide and sodium azide which strongly inhibit carbonic anhydrase cannot be used for this purpose, because being unspecific they inhibit also the activity of several other important catalytic systems of cells. It has been demonstrated, however, by Davenport that thiocyanate ions inhibit to about the same degree both the activity of carbonic anhydrase and the gastric secretion of hydrochloric acid induced by histamine. These observations have been brought forward by him as strong additional evidence supporting the view that carbonic anhydrase plays an important part in the gastric secretion of hydrochloric acid.

It was shown recently by Mann and Keilin[3] that carbonic anhydrase is very strongly inhibited by sulphanilamide and that this inhibition is reversible and highly specific. Moreover, the inhibition of this enzyme by sulphanilamide is of a much higher order of magnitude than that by thiocyanate. Sulphanilamide forms, therefore, a most valuable reagent in the study of the physiological significance of carbonic anhydrase in the blood and in the gastric mucosa. In the present communication we shall deal, however, only with the problem of the interrelationship between carbonic anhydrase and the gastric secretion of hydrochloric acid.



GASTRIC SECRETION OF HYDROCHLORIC ACID IN SIX CATS INDUCED BY INJECTION OF 0·5 MGM. HISTAMINE PER KGM.: *A* AND *B*, CONTROLS; *C* AND *D*, AFTER INJECTION OF SODIUM THIOCYANATE; *E* AND *F*, AFTER INJECTION OF SULPHANILAMIDE.

Our experiments were carried out on cats starved for about 15 hours. Under ether anæsthesia, the brain was pithed from an opening made in the second vertebra. Artificial respiration was then applied while the administration of ether was discontinued. The cardiac end of the stomach was ligatured and a cannula was tied into its pyloric end, taking special care to preserve the normal blood circulation of the stomach intact[4]. Sodium thiocyanate (0·2 gm./kgm.) or sulphanilamide (1 gm./kgm.) were injected intravenously one to two hours before the subcutaneous injection of histamine dichloride (0·5 mgm./kgm.). The stomach was washed, filled with 20 c.c. of warm saline solution which, every 40–50 minutes, was removed, titrated for free hydrochloric acid and replaced with fresh solution.

Cats		Gastric secretion of			Gastric mucosa	
		Free acid (c.c. $m/100$ HCl)	NaCNS mgm.	Sphmd. mgm.	NaCNS (*M.*)	Sphmd. (*M.*)
Controls	*A*	379				
	B	291				
Injected with sodium thiocyanate	*C*	29	4·4		$2\cdot7 \times 10^{-3}$	
	D	96	7·0		$1\cdot8 \times 10^{-3}$	
Injected with sulphanilamide (Sphmd.)	*E*	443		287		$7\cdot2 \times 10^{-3}$
	F	736		174		$2\cdot3 \times 10^{-3}$

Thiocyanate and sulphanilamide were estimated in the successive samples of saline solution removed from the stomach (see accompanying table) and in samples of blood, where their concentrations until the end of the experiment were never lower than $4 \times 10^{-3} M$ and $6{\cdot}4 \times 10^{-3} M$ respectively. At the end of the experiment the blood vessels of the stomach were perfused with saline solution, the stomach removed, the gastric mucosa separated from the muscular coat, ground with sand and ten volumes of water and centrifuged. The opalescent extract collected was estimated in the usual way for the activity of carbonic anhydrase and for the contents of thiocyanate or of sulphanilamide. Control cats were treated in the same way except that they were not injected with either thiocyanate or sulphanilamide.

The main results of these experiments, typical examples of which are shown in the figure and the table, can be summarized as follows:

(1) Both thiocyanate and sulphanilamide are excreted by the gastric mucosa and reach a fairly high concentration within the mucosa itself. It is therefore reasonable to assume that they have reached the carbonic anhydrase and had time to react with it.

(2) Thiocyanate, while it strongly depresses the gastric secretion of hydrochloric acid stimulated by histamine, is not a strong inhibitor of the carbonic anhydrase.

(3) Sulphanilamide, on the contrary, while it either does not affect the secretion of hydrochloric acid stimulated by histamine, or even increases it, inhibits completely the activity of the gastric carbonic anhydrase.

The results of these experiments do not seem therefore to support the view that carbonic anhydrase catalyses directly the gastric secretion of hydrochloric acid. This does not exclude, however, the possibility that the enzyme may yet have an indirect connexion with the gastric secretion of HCl, considering that this secretion is known to be accompanied by an increase in the total base of the serum[5,6]. That the carbonic anhydrase takes part in the acid-base metabolism of the body is moreover indicated by the well-known disturbance in the acid-base equilibrium which follows the administration of sulphanilamide.

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Blood Groups of Anthropoids

Candela[1] has collected previous data on the blood grouping of 137 anthropoids, and added 11 more of his own, based on urine tests. 99 of the animals are chimpanzees, in which only groups *O* and *A* have so far been found. In the orang, gorilla, and several gibbon species all members belong to groups *A*, *B* or *AB*. This distribution in them is shown in the accompanying table.

Genus	*O*	*A*	*B*	*AB*	*AB* (calc.)
Orang	0	8	10	5	11·41
Gorilla	0	6	3	2	5·09
Gibbon	0	2	7	2	4·36

The last column gives the numbers of *AB* animals expected if there were random mating within the genus the members of which are grouped together. For in the absence of group *O* we can be reasonably sure that all, or almost all, *A* and *B* animals were homozygous, if the genetics of blood groups are the same in apes as in men. Thus of 46 orang chromosomes 21 carried *A* and 25 *B*. If mating were at random we should expect a frequency $\frac{2 \times 21 \times 25}{46^2}$ of *AB* among orangs, or 11·41 out of 23. The total of *AB* found is 9, as compared with 20·86 calculated. The difference is 3·6 times its standard error, and certainly significant.

The non-randomness of mating may be due to the existence in these genera, as in man, of different blood group frequencies in different areas, or to inbreeding, or both. A fairly intense degree of inbreeding would be needed to halve the expected proportion of heterozygotes. This would, for example, occur if 80 per cent of all matings were between brother and sister, the rest being at random. It is at least equally probable that the distribution of blood groups in these genera varies geographically at least as much as in man. Unfortunately many of the papers in the literature do not even give the species or subspecies of anthropoid investigated, and very few if any give the place of capture or those of the wild ancestors.

Hence no conclusion on this matter is possible. It is of importance that these data should be given in all future work, if only because their results may throw light on the origin of the differences between human races as regards blood group membership. The chimpanzee, of which 99 have already been grouped, seems to be much the most hopeful animal for this purpose. It is the object of this note to direct the attention of workers in this field to so important a desideratum.

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Function of Nicotinic Acid in the Metabolism of the Colon-Typhoid Group of Bacteria

We have already[1] presented data indicating that nicotinic acid does not act as a specific 'growth factor' in the limited sense, but as a part of an activator of glucose fermentation. In the semi-synthetic medium used, growth of *S. paratyphi* A. and *Shigella dysenteriæ* Shiga occurred in the absence of nicotinic acid; however, when glucose was added to this medium, active fermentation took place only

when nicotinic acid was added. In order to test the validity of this conclusion, these studies were extended to include other fermentable substances under a variety of conditions. The full results will be published elsewhere, but we wish to direct attention now to a number of points of special interest.

(*a*) Using the photo-electric colorimeter for measuring growth density (a more accurate method than naked eye observation and much simpler than the plate-count method) we noted the following paradoxical effects: (i) Glucose added to our medium free of nicotinic acid inhibits growth; growth was better in the absence than in the presence of glucose. This inhibiting effect was produced by all sugars fermented by the organisms used in the experiments, with the exception of maltose; and conversely it was not produced by sugars such as sucrose not fermented by these organisms. (ii) Similarly, nicotinic acid added to the medium in the absence of a fermentable sugar or acid (lactic or acetic) inhibits growth. The inhibitive effect of the nicotinic acid is produced by such minimal concentrations as are still effective in influencing fermentation when fermentable sugars are present.

These effects are illustrated by typical results given in Table 1.

TABLE 1. GROWTH DENSITY IN THE BASIC MEDIUM AND WITH THE VARIOUS ADDITIONAL SUBSTANCES ADDED.

Without nicotinic acid		With nicotinic acid	
Medium	Growth density*	Medium	Growth density
Sterile medium	100	Sterile medium	100
Basic medium	84	Basic medium	90
,, + glucose 0·01%	97	,, + glucose 0·01%	77
,, ,, 0·05%	97	,, ,, 0·05%	63
,, ,, 0·20%	97	,, ,, 0·20%	65
,, + maltose 0·2 %	88	,, + maltose 0·2 %	70
,, + sucrose 0·2 %	84	,, + sucrose 0·2 %	90

* The numbers indicate the relative growth density; the highest numbers represent least turbidity, and conversely.

(*b*) The addition of nicotinic acid to media containing a fermentable sugar or acid (lactic or acetic) is followed by active fermentation leading to a breakdown of the substance: (i) When glucose is used, lactic and acetic acid and carbon dioxide are the principal products. (ii) When sodium lactate is used, the end products depend on whether or not nicotinic acid is present. In the latter case, a small part of the lactic acid is oxidized to acetic acid, but the process goes no further; in the former case, that is when nicotinic acid is added, complete oxidation of the lactic acid results and the acetic acid is converted to carbon dioxide, that is, carbonates. In lactic acid – containing media to which a suitable indicator is added, no change in reaction occurs in the absence of nicotinic acid, while a marked alkaline reaction is developed in the presence of nicotinic acid. The density of growth parallels the intensity of fermentation.

(*c*) By means of dehydrogenation experiments by the Thunberg procedure with washed cells (using lactate as donator), it was possible to show that organisms grown in glucose or lactate media with nicotinic acid reduced methylene blue, while those grown in media without nicotinic acid failed to reduce methylene blue. If the washed organisms used in the system were grown in the presence of glucose or sodium lactate, together with even minimal amounts of nicotinic acid (0·005 γ/c.c.), they reduced methylene blue fairly promptly. If the washed bacteria were grown in the absence of nicotinic acid, and then nicotinic acid added to the respiration system, the reduction was delayed and occurred only after an incubation time which was at least twice that required by the control culture grown in the presence of nicotinic acid. It seems, therefore, that the nicotinic acid is first converted into a codehydrase (cozymase ?) before it can act. Some typical data are shown in Table 2.

TABLE 2. REDUCTION TIME IN RESPIRATION EXPERIMENT WITH WASHED CELLS OF BACTERIA GROWN IN MEDIA CONTAINING SODIUM LACTATE WITH AND WITHOUT NICOTINIC ACID.

Source of cells	Substances added to system	Time for complete reduction of methylene blue (1:5000)*
Medium + 0.005 γ N. acid	Nic. acid, 10 γ	98 minutes
,, –	,, ,, 10 γ	193 ,,
,, + 0·005 γ N. acid	Nothing	163 ,,
,, – ,,	Nothing	No reduction
,, + 0·005 γ N. acid	Cozymase 0·2 c.c.	50 minutes
,, – ,,	,, 0·2 c.c.	50 minutes

* *M*/20 lactate served as donator.

These data explain some discordant results in the literature[2,3]. It has not previously been suspected that glucose (in the absence of nicotinic acid) inhibits growth; even 0·01 per cent glucose is sufficient to give this effect. It also appears that in the absence of a fermentable carbon compound minimal amounts of nicotinic acid exert an inhibitive effect on growth.

The results show further that nicotinic acid acts only after it is converted by the cell into an activator (a codehydrase ?), and by making available a simple source of energy it affects a more accelerated and abundant growth. The function of nicotinic acid is, therefore, as a part of cozymase, a function which it probably fills also in the animal body.

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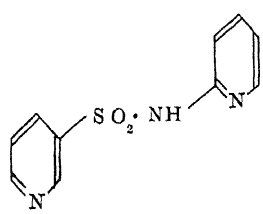
Pyridine-3-sulphon-(2-pyridyl)-amide; a Note on the Modelling of Chemotherapeutic Agents

THIS compound (I) was prepared for the following reason: pyridine-3-sulphonic acid and its amide were found to inhibit bacterial growth, apparently by interference with nicotinic acid metabolism[1]. Sulphanilamide appears to act as a therapeutic agent by interfering with the utilization of *p*-aminobenzoic acid by the invading organisms[2], but the 2-aminopyridine derivative (*M. & B.* 693) is in many cases more effective. Following a rule of thumb method common in chemotherapeutic research, the *M. & B.* 693 analogue of pyridine-3-sulphonic acid, (I), was prepared

and its inhibitory powers compared with those of the parent acid and amide by *in vitro* tests analogous to those previously described[1,2]. The compound was found less active than the simple acid and amide.

In terms of the theory[3] on the basis of which pyridine-3-sulphonic acid was first investigated, which relates several inhibitory compounds to definite structures (for example, *p*-aminobenzoic acid, nicotinic acid) of importance to the organisms concerned, such failure to produce a more active compound can readily be understood. There is considerable specificity between the mutual effects of *p*-aminobenzoic acid and sulphanilamide, and between nicotinic acid and pyridine-3-sulphonic acid. *M. & B.* 693 is possibly related equally specifically to a derivative of *p*-aminobenzoic acid. Unless, therefore, the natural nicotinic acid derivatives are similar to those of *p*-aminobenzoic acid, it is unlikely that a group which enhances the activity of sulphanilamide will enhance that of pyridine-3-sulphonic acid.



I

Instances of failure to produce more active 'hybrids' in this manner are common in chemotherapeutic literature; for example, among sulphanilamide derivatives themselves, diethylaminoalkyl[4], quinoline[5], tropinone[6] and dihydrocuprein[6] derivatives are described as of relatively little activity, and hybrids between quinine and emetine[7] have not the activity of optimal members of the component series. It is suggested that the reason for such lack of success may be the same as in the case of the present pyridyl compound. Though corresponding essential metabolites are not in these cases known, it is not likely that they will be closely related to one another; known essential metabolites, for example, the vitamins, are very diverse in structure.

Preparation of (I). Pyridine-3-sulphonyl chloride (from 2·5 gm. of the acid) and 2-aminopyridine (1·5 gm.; I am indebted to Dr. A. J. Ewins for this material) were mixed in pyridine (5 ml.), warmed at 100° for ½ hr. and water (20 ml.) added. The product separated on cooling and was recrystallized from alcohol (60 ml.) yielding colourless prisms (1·8 gm.) m.p. 185° (found: C, 50·8; H, 4·0; N, 17·9; S, 13·5 per cent).

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An Electron Diffraction Study of the Surface of Magnesium attacked by an Aqueous Chloride Solution

It is well known that magnesium is vigorously corroded by an aqueous chloride solution. However, previous investigations have always been macroscopic, and did not touch the mechanism of the phenomenon directly. The present study by electron diffraction may provide a fuller knowledge of this phenomenon than hitherto.

In the first stage of corrosion by a chloride solution, simultaneously with the evolution of hydrogen gas, the magnesium became covered with a black porous substance, and then the dark-coated surface in turn became coated with a white porous substance. Upon examining both the black and the white substances by the reflection method of electron diffraction, it was found that they are one and the same, consisting of crystals of magnesium hydroxide, $Mg(OH)_2$, and oxide, MgO; the hydroxide, according to the intensity of the diffraction rings, being present in a slightly larger quantity than the oxide.

Now it is known that magnesium is scarcely corroded in water, and it has been suspected that some sort of a protective film must exist on the surface. This surface film was detected by electron diffraction, which revealed the existence of a mixture of the $Mg(OH)_2$ crystals (large amount) and the MgO crystals (moderate amount). Therefore, the Cl^- ion plays the part of a catalyst in the reaction between magnesium and water, producing magnesium hydroxide and oxide. The diffraction rings from the surface substances produced in water are not so sharp as those from the substances produced in a chloride solution; hence the crystal size of the former is smaller than that of the latter. Using the equation for crystal size introduced by M. von Laue in 1926, that for the magnesium hydroxide is about 50 A., while that for the magnesium oxide is about 70 A.

It is a pleasure to acknowledge that this work has been done under the direction of Dr. Ichiro Iitaka.

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Blunted Teeth of Lymnæidæ

EXAMINATION of the anterior extremity of the radula of Lymnæidæ reveals a few 'blunted' teeth, but there are sometimes thirty to forty rows of worn teeth in an old mollusc, as seen among the late Prof. Gwatkin's material at the Natal Museum.

Older specimens also contain more rows of teeth than immature ones. New rows are added from the nascent posterior border and the number of tricuspid teeth is increased by coalescence of the cusps of marginal teeth.

Invertebrate teeth are more likely to grow than those of vertebrates which have erupted, and shedding of molluscan teeth is a less frequent process than is commonly supposed.

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RESEARCH ITEMS

Ancestral Longevity and the Sex Ratio

MATERIAL from family history records in the Department of Biology of the School of Hygiene and Public Health, Johns Hopkins University, has been used by Philip S. Lawrence to answer the question whether the children or grandchildren of long-lived progenitors exhibit on the average a higher male sex ratio than of those dying at a relatively young or average age (*Human Biology*, 12, 3; 1940). It would appear that there is a positive association between the mean male sex ratio of children and the longevity of their parents, and further that this is more pronounced for the duration of life of the mothers than for that of the fathers. In the second generation, it is also higher when the grandparents died at advanced ages. Hence it is suggested that, on the average, the most vigorous part of the population produces the highest proportion of male offspring. At the same time, there is no suggestion in the present study that the sex ratio of offspring has any association, positive or negative, with the fertility of the parents. It is quite probable that where either one or both parents were long-lived, they had produced a greater mean number of children and grandchildren than when both were shorter-lived, but beyond the age of productivity. This indicates that individuals that possess the greatest amount of innate constitutional vigour are, by and large, the most highly fertile of the population. Experiments on *Drosophila melanogaster* strongly indicate that the offspring of parents that died at older ages have a higher average male sex ratio than the offspring of parents that died at younger ages. The association is particularly true with respect to the maternal organism. The data fail to show any regular association between fertility and the duration of life of fathers; but for mothers an increase in longevity was accompanied by an increase in fertility both for production over the entire life-period, and also during particular portions of the life-span.

Evolution of the Mammalian Palate

THE detailed investigation to which the skulls of fossil reptiles has been subjected in recent years offers new opportunities for the examination of mammalian homologies. Largely on embryological evidence, the mammalian vomer has been generally regarded as a development of the reptilian parasphenoid, but F. R. Parrington and T. S. Westoll regard the palæontological evidence as indicating the truth of the earlier view that the paired 'pre-vomers' of the reptile fused to form the mammalian vomer (*Phil. Trans. Roy. Soc. Lond.*, B, **230**, 305–355; 1940). Thus direct fossil evidence shows that the Triassic Theriodonta possessed vomers and palatine processes directly comparable with those of mammals, and that these were developed from the reptilian prevomers and premaxillæ respectively. Accordingly, the term 'pre-vomer' is really synonymous with vomer and its use should be discontinued. In the monotremes the 'mammalian pterygoid' and '*Echidna*-pterygoid' are shown to be homologous respectively with the pterygoid and ectopterygoid of the Theriodonts and other reptiles, and in ditrematous mammals the pterygoid includes the homologue of the reptilian pterygoid. In general, in the development of the mammals the snout region and the dentary have been comparatively little modified, but there has been a notable shortening of the post-dentary region, the posterior part of the pterygoids, and the orbitosphenoid, although this shortening does not extend to the roof of the skull.

Nesting Conventions of the Black-headed Gull

IT has been stated by F. B. Kirkman that the territory of a black-headed gull (*Larus ridibundus*) has no fixed boundary, but subsequent observation leads him to modify that view (*British Birds*, **35**, 100; 1940). Measurement of the distance between a relatively small number of nests in a single colony showed that the minimum between nesting groups was 1½ ft., except in two cases when the distance was 2 or 3 inches less. Nests were moved closer than the 1½-ft. limit, and as a result of observing the reactions of their possessors towards their neighbours he comes to the conclusion that an 'inner territory' exists "that serves exclusively to determine its space relations with its next neighbours in its nesting group. Next neighbours may be some feet apart, but they must not, as a general rule, be less than 1½ feet". This inner territory is recognized as a prohibited area by the neighbours themselves, since they avoid intruding upon it, at any rate when the owners are present, and its biological value is said to be that, while allowing a certain proximity, it keeps nesting neighbours sufficiently apart to prevent contact and strife. A weakness of the paper lies in its failure to confirm the observations by measurement of the distances between a much greater number of nests and of nests in different colonies. Perhaps the author in further investigations may be able to correlate the reach or striking distance of a black-headed gull with the distance between nests.

New Termite Intercastes

A. M. ADAMSON has described intercastes of two species of termites (*Proc. Roy. Soc.*, B, **129**; 1940). It appears that an individual of *Nasutitermes guayanæ* from Trinidad represents the only known termite intercaste combining important features of two castes. The head is soldier-like in most of its features but the compound eyes, ocelli and some other characters are those of the reproductive caste. The pronotum is intermediate between that of the soldier and reproductive castes, while the wing-buds bear resemblance to those of the reproductive nymph but with adult pigmentation of the wings. Two soldiers of *Microcerotermes arboreus*, also from Trinidad, with wing-buds, exceptionally large vestigial eyes and with the pronotum intermediate between those of the soldier and reproductive castes are also described. The significance of these intercastes is discussed, and they lend support to the opinion of A. E. Emerson and others that the worker caste arose phylogenetically from the soldier. The author concludes that the subject of the origin of the intercastes must await further studies on the general problem of caste determination.

Fructosans in the Monocotyledons

A LARGE number of fructose polymers, distinguished from inulin by their great solubility in cold water, have been found in recent years widely distributed in Monocotyledons. These substances form the subject of a useful review, under the above title, in the *New Phytologist* (**39**, May 1940). Owing to their mucilaginous and non-crystallizable nature, the isolation of these substances as chemical entities has seldom been achieved, and the establishment of their constitution by the methylation technique of Haworth has as yet made little headway. Seasonal changes in fructosan content in such a plant as barley indicate that under normal conditions there is an increase of fructosans in the whole plant until stem elongation is complete. Afterwards the amount of fructosan present diminishes, but it is not clear whether they are utilized in respiration, or synthesis of polysaccharides or proteins. The leaves contain only a small fraction of the total; the bulk is present in the stem and ears where they probably arise from hexoses, the latter themselves produced from the inversion of sucrose, the carbohydrate which is probably translocated to these regions. Seasonal changes in the fructosan content of Iris, Lycoris and Asphodelus suggest a similar storage role; they accumulate during the period of leaf activity, in leaf-base and rhizome, and are partially used up during seed production.

Studies of Meiosis

O. H. FRANKEL (*J. Genetics*, **41**, 419–34; 1940), C. D. Darlington (*J. Genetics*, **41**, 35–48; 1940), C. D. Darlington and L. La Cour (*J. Genetics*, **41**, 49–64; 1940) provide data from Fritillaria, Lilium and Tulipa which sheds some light on the factors governing pairing and chiasma formation. These factors would appear to be the position of the start of pairing, the length of time allowed for pairing to take place and the basic cause of chiasma-formation —believed to be torsion in the paired regions. Frankel shows that pairing starts practically always near the centromere in Fritillaria. A second contact point in the distal region shows its effect if the time allowed for pairing is sufficient. The time allowed for pairing also controls the amount of pairing of the chromosome. Bivalents with median centromeres are delayed in pairing as compared with bivalents with subterminal centromeres, and therefore show various differences in behaviour. It is believed that there is an inverse relationship between the extent of time for pairing and the degree of torsion. The statistical analysis of chiasmata in triploid Fritillaria and in the hybrid *Lilium testaceum* provides further evidence regarding the order of pairing and the ways in which this is interrupted. The higher chiasma frequency per configuration of a triploid is shown to be related to the change of partner and the increased number and distribution of contact points of pairing. Pairing proceeds at a more variable rate, and its average rate is lower in the hybrid *Lilium testaceum* than in the species.

A Chimæra in Sorghum

J. B. SIEGLINGER (*J. Hered.*, **31**, 363–364; 1940) has found a bilateral chimærical plant of Sorghum in the F_5 generation which was segregating for red and white pericarp colour. One half of the panicle contained white seeds which were striped red on the basal portion while the other half of the panicle bore the normal red seeds. The different types of seed produced similar progeny, thus indicating that the embryonic tissue was not influenced by the mutation which gave rise to the striped pericarp.

Interatomic Forces and Helium in Rocks

UNDER this title, N. B. Keevil discusses (*Proc. Amer. Acad. Arts and Sciences*, **73**, 311–359; 1940) the fate of the helium atoms generated in rocks from radioactive elements, with special reference to the factors which might permit some diffusion of helium through rocks during the vast extent of geological time. Consideration of the dimensions of the helium atom and construction of potential energy curves involving helium show that the size is large compared to the structural 'holes' in common minerals. The chance of escape through distortion channels resulting from radioactive decay should be high in radioactive minerals, but small in ordinary rock minerals. Calculations indicate that an opening 1·2 A. wide would have to be formed before escape would be possible. If diffusion were possible through crystal structures the effect would be so extensive during geological time that a uniform concentration of helium throughout a given rock would by now have been attained. Discussion of several factors suggests that migration of helium in ordinary rocks should normally be less than about eight per cent. With imperfections due to strains during crystal growth or subsequent alterations greater losses may be expected. Helium may be expelled completely during recrystallization, but mild thermal metamorphism would appear to have no effect. It is concluded that while 'helium-ages' of rocks are usually considered as minima, this preliminary survey of the problem indicates that ages obtained on carefully selected minerals should not differ from the true values by more than the present experimental errors of measurement.

Polyisobutylene

Brill and Halle, in 1938, showed that when polyisobutylene was stretched the amorphous X-ray diagram was replaced by a fibre pattern analogous to the case of natural rubber. They determined the identity period and concluded that the stretched molecules are not planar zig-zag in shape but because of the methyl side groups are probably helical. C. S. Fuller, C. J. Frosch and N. R. Pape (*J. Amer. Chem. Soc.*, **62**, 1905; 1940) have re-investigated the substance and have generally confirmed these results. The chain molecules in the crystalline regions assume a coiled form and possess a 1 : 3 disposition of the methyl groups. The fibre identity period is found to be 18·63 A. and this is assumed to be the c distance of an orthorhombic cell, the a and b distances being 6·94 A. and 11·96 A. This is based on a very probable molecular scale model, but other models are not absolutely excluded. The one chosen is consistent with the X-ray results; it gives the chain configuration in isobutylene as that of a helix in which the successive methyl group pairs pack together in a staggered arrangement. This requires successive partial rotations of the methyl group pairs at an angle of 45° around the molecular axis, with coincidence after eight rotations. Diagrams of the models are given in the paper. The space symmetry group suggested is identical with that proposed by Meyer and Mark for natural rubber, but later work has modified this in favour of a less symmetrical space group.

WINDOW BREAKAGE BY BOMB-BLAST

THE October number of the *Journal of the Institute of Physics* contains a special article by Dr. H. Moore, director of research for Pilkington Brothers at St. Helens, dealing with some physical problems of war-time window breakage. The effects of bomb-blast were studied experimentally by using small 2-lb. charges of blasting powder exploded under suitable conditions. Instantaneous photography of 7-ft. square ½-in. plate glass windows showed that typically, under blast, the damage occurs in two stages. In the first, during the compression period the centre of the glass is forced inwards as a diaphragm, and ring and radial cracks develop. In the second stage, before the pieces have time to separate, the 'suction' half of the wave comes into effect and the pieces fall towards the bomb. If the glass is very near to the bomb so that all the air is displaced by the gases from the explosive, the broken pieces are driven away from the bomb. Short of blocking up a window with brickwork or enclosing it in shutters of heavy timber or stout steel it is practically impossible to safeguard the glass against fracture.

Attention was therefore directed to studying methods of preventing personal injury from flying fragments of glass. Consistent with previous results, sheets of transparent cellulose or fabric are effective if firmly fixed to the glass and carried well over and securely fixed to the edges of the window frame. Complete coverings are always better than separate strips of the same materials. The adhesive must be chosen with care, but ordinary flour paste as used by paperhangers may be used with reasonable safety. Although sodium silicate or water-glass gives excellent adhesion the glass will be etched and left permanently 'greyed'. Toughened glass and panes reinforced internally with wire mesh stood up well to the effects of blast.

Unless the explosion is very near to the window, glass fragments due to blast usually burst outwards. Fragments of glass, debris or bomb casing may, however, still be thrown inwards. Some protection from these is secured by 'lengthening the time of the blow'. For this purpose leaded panes, thick curtains, two or three thicknesses of hessian or ½-in. wire netting stretched on wooden frames and hanging freely some 3–6 in. from the glass have all proved effective.

In the same article the problem of blacking-out roof lights is briefly discussed. One solution was the use of coloured sources of artificial light emitting only a restricted range of the visible spectrum. The windows and roof-lights were then painted with a varnish transmitting only the complementary visible range. When workers found difficulty in getting accustomed to the coloured lighting, the quick and cheap method of painting the glass with black paint was widely adopted. Reasoning showed that windows exposed to strong sunlight might crack unless they were painted upon the outside—or upon the inside, according to the argument used. Observation showed that the windows were liable to crack in strong sunlight, on whichever side of the glass the paint was put. A study of the conditions showed that cracking was due to temperature differences between different regions of the glass sheet, and not to differences of temperature through the thickness. Cracking was avoided when all parts of the glass, and particularly the edges, were exposed to the radiation in the same way as the centre and if the edges were constrained no more rigidly than in the ordinary fixing with putty.

INDIAN FISHES OF ECONOMIC VALUE

SEVERAL interesting papers on Indian fishes are included in recent numbers of the *Records of the Indian Museum*. The most important of these are two on the Indian shad ("On Some Early Stages in the Development of the so-called Indian Shad", *Hilsa ilisha* (Hamilton) by K. Krishnan Nair[1] and "Further Observations on the Bionomics and Fishery of the Indian Shad", *Hilsa ilisha* (Hamilton), in Bengal waters by Sunder Lal Hora and K. K. Nair[1]). Hilsa is a clupeoid, closely related to the herring, and forms an important fishery. It breeds in the river throughout the year, and the two breeding peaks, large and small, are shown to be correlated with the flooding of the river owing to the monsoon and the nor'westers respectively. The young migrate down the river, and the upstream migration on which the main fishery depends is attributed to the monsoon and the state of maturity of the migrating individuals. A brief account is given of fluctuations in the year-to-year Hilsa fishery, and it is surmised that a five-year cycle exists in the fishery of this species. Hilsa can flourish well in confined fresh waters and even attain maturity. From the discovery of a regular fishery of young Hilsa in cold weather near Calcutta it has been suggested that more attention should be paid to the conservation of the Hilsa fisheries rather than to the establishment of hatcheries for the artificial rearing of the fish.

The collection and hatching of the eggs continues as a routine at Madras and, in Calcutta, owing to the continuation of biological investigations at the Pulta Waterworks by the Zoological Survey of India, a considerable amount of information on the bionomics of this fish has been collected. It was from this latter material that Nair made his observations on the larval forms, giving special attention to the number of vertebræ and changes in the relative proportions of the fish during growth.

T. J. Job ("On the Breeding and Development of Indian 'Mosquito-fish' of the genera *Aplocheilus* McClelland and *Oryzias* Jordan and Snyder"[2]) has investigated the life-histories of those fishes which are commonly used as mosquito controls. The genus Aplocheilus is the most important, and the breeding of three species of these is described; also that of *Oryzias melastigma*. The so-called 'killifishes' have

been found to be of immense value in the biological control of mosquitoes. These researches are important and very interesting. The development of Aplocheilus is rapid, and metamorphosis takes place in about three weeks after hatching; from this stage onwards mosquito larvæ are eaten. The eggs of all the species of this genus are laid separately and are attached by threads to weeds. In Oryzias the female carries her eggs in clusters, in some species throwing them off so that they become entangled in weeds. Thus there is a certain amount of parental care, and in *O. melastigma* they may or may not be carried until hatched. This species stays long in the larval state, and it may be one and a half months old before feeding on mosquito larvæ.

All these studies of life-histories are valuable, and it is hoped that more may be done on similar lines.

[1] *Rec. Indian Mus.*, **41**, Part 4 (1939).
[2] *Rec. Indian Mus.*, **42**, Part 1 (1940).

THE INORGANIC ELEMENTS IN NUTRITION

EXTENSIVE investigations made within recent years and demonstrating the importance to human nutrition of minute quantities of various mineral elements were reviewed by Prof. E. V. McCollum, professor of biochemistry in the Johns Hopkins University School of Hygiene and Public Health, in a paper read at the University of Pennsylvania Bicentennial Conference on September 17.

The early literature of nutritional research placed emphasis almost entirely on proteins, carbohydrates and fats, and gave little attention to the inorganic nutrients, in spite of the fact that Liebig, about 1830, had shown the importance of minerals as fertilizers for the growth of plants. However, it must have been dimly appreciated that, since the bones contain so much calcium phosphate, an adequate supply of these elements must be provided for growing creatures. The appetite for common salt was accepted as evidence for the need of sodium and chlorine. Isolation of hæmoglobin by Hoppe-Seyler in 1862 stimulated investigations of the role of iron in the body, and during the last quarter of the nineteenth century physiologists studied some of the fundamental problems relating to the physiological action of salt solutions, including the development by Ringer of his famous solution. By the beginning of the twentieth century research in the mineral elements of nutrition had made much progress, and it is now known that at least thirteen inorganic elements are concerned with biochemical processes and must be provided in adequate amounts in the diet.

More than thirty years ago Dr. H. C. Sherman, of Columbia University, showed that calcium is one of the elements in which the human diet is frequently deficient. Milk and leafy vegetables are the only foods commonly eaten by man which are rich in calcium, and the rather poor utilization of the calcium of several green vegetables is due to their high content of oxalic acid, which interferes with calcium absorption. The calcium problem in human nutrition was intensified by the perfection of milling machinery so that all the mineral-rich parts of the grain could be removed from the part which is sold as flour, and to the rise during the last century and a half of the consumption of sugar, which now stands at an average of more than one hundred pounds per capita per annum. The large fraction of the total food supply taken in the form of refined cereals and sugar, the latter entirely free from mineral elements, puts upon the remaining portion of the diet the burden of supplying almost the entire inorganic needs of the body.

The effects of calcium deficiency range from a decreased rate, or cessation of growth, to premature death. Many of the effects are due to the shortage of this element in the blood, which normally contains only 1 per cent or less, of all the calcium in the body, 99 per cent being in the bones and teeth.

Prof. McCollum referred briefly to the researches conducted around 1922 which showed that lack of vitamin D was a principal cause of rickets, a disease in which there is poor development of bones and teeth. Previous to 1922, the cause of rickets was unknown, although the disease had afflicted millions of infants and children in temperate regions throughout the world during many hundreds of years. Simply supplying calcium and phosphorus, the main ingredients of bone, was not sufficient. These minerals could not be built into bone, it was then found, without the assistance of vitamin D. It was Prof. McCollum and his associates who demonstrated this fundamental fact by noting that the sudden introduction of cod liver oil into the diet of a rat with rickets was followed by deposition of lime salts in the bone. The freshly deposited lime showed in the X-ray as a distinct line across the head of the bone, and became a test of the curative effects in treating rickets. It was later shown by a number of research workers that sunlight on the body or artificial irradiation of foods caused the formation of vitamin D in the body or foods and prevented or corrected rickets in children.

Next to the nutritional problems traceable to deficiencies of calcium and phosphorus and vitamin D (and these are now in great measure being prevented), anæmia due to deficiency of iron is perhaps the most widespread inorganic nutritional problem. Apparently about 50 per cent of the iron in cereal grains and certain other common goods is in the so-called 'hæmatin' form, in which it is not available for assimilation by man or animals. It has been noted that the utilization of iron by the system is impaired when the supply of ascorbic acid (vitamin C) in the diet is inadequate, and there are reports that anæmic persons on a low iron diet show a marked response in the number of red blood cells and the hæmoglobin percentage when ascorbic acid is given to them. Also iron tonics in certain cases have led to no improvement in the blood until fresh fruits or raw vegetables which are good sources of vitamin C are included in the diet. Prof. McCollum remarked that preventable or curable anæmia is so widespread and so common that these newer observations on the manner of assimilating iron are of great practical significance.

It has been shown also that copper is important in connexion with the utilization of iron, and that copper deficiency is fairly widespread among infants.

One of the most interesting mineral elements, in its behaviour in the animal body, is manganese. Rats given a diet deficient in manganese were unable to suckle their young, and they showed no normal maternal instincts. Many of the neglected young rats died within a few hours. Deficiency of manganese in chickens produces a condition known as 'slipped tendon', or perosis, in which the angle joint is displaced and the birds crippled so badly they usually die. Hens deficient in manganese lay eggs of very low hatchability, many of the chicks dying in the shell a few days before the time for hatching. These embryos are often deformed, having short, thickened leg and wing bones and globular heads. When manganese is injected into hens deficient in the mineral the eggs hatch normally and produce chicks with normal bones. At present there is no evidence concerning the occurrence of manganese deficiency in human beings.

Reference was also made by Prof. McCollum to the demonstration of cobalt deficiency as the cause of a blood disease in sheep and cattle known variously throughout the world as 'Denmark disease', 'coast disease', the 'pines', 'bush sickness', and 'salt sick'. The animals suffering from the disease were found to have been grazing on pastures the soil of which was deficient in cobalt. The investigations which proved the point constitute one of the classics of nutritional research. This disease, it will be recalled, has been the topic of articles and correspondence in NATURE during recent years.

AFFINITIES IN THE PUEBLO CULTURE OF ARIZONA*

DR. FRANK H. H. ROBERTS, JUN., continues his report on his archæological excavations of the Whitewater Anasazi or Basket-Maker-Pueblo remains in Eastern Arizona (see NATURE, **144**, 556; 1939) by an account of the pottery, and objects of bone, stone and shell which were found, as well as of the burials which were examined. From the burials skeletal remains of 150 individuals were discovered, but of these 15 only were sufficiently well preserved to permit of recovery, examination and report.

The objects recovered by the investigation permit of a very partial view only of the material culture of the inhabitants. Virtually the whole of the products of their industry made of perishable material is missing. A few potsherds bear the impress of basketry, while a few charred pieces of cord were found. The basketry was of the characteristic coiled form. There is no evidence of clothing, textiles or wooden implements, though these must have played a large part in their lives.

The specimens collected were found in the remains of houses, in the various refuse mounds, as offerings accompanying burials, in a few instances on the old occupation surface near dwellings and outside fire-pits. No articles appear to have been made specially for funerary purposes.

Most of the artefacts represent one stage, the Developmental Pueblo, though there are a few from the earlier stage, the Modified Basket-Maker, and the later, the Great Pueblo. Dated timbers from the various structures indicate datings ranging from the early part of the ninth century to the early years of the eleventh century A.D. Pottery sequences have been checked and confirmed by stratigraphic evidence.

True pottery first appears in the Anasazi province in the Modified Basket-Maker stage. Vessels were occasionally made of unfired clay tempered with shredded cedar bark or grass, the prototype of the later makes that came to play so prominent a part in the life and industry of the people. In some instances the bottoms were moulded in baskets, the walls or rims being formed of fillets of clay looped around the upper edges. Others were fashioned entirely by hand without basal support by a coiling process. The principal shapes were shallow trays and deep bowls. The unfired clay objects may be attributed to influences from regions to the south but the methods used seem to have been mainly indigenous, since the Basket-Makers were already adepts in the use of clay for architectural purposes, as for example in the jug-like necks of the tops of their granaries and the mud steps placed on granary walls. When firing of clay developed, the cedar bark binder was replaced by sand, which in turn was gradually replaced by powdered rock, and this in the Developmental Pueblo period by ground potsherds.

The Modified Basket-Maker phase had developed a variety of shapes in its pottery, while protruding particles in the paste gave it a characteristic irregularly stippled appearance. Decoration for the most part was confined to the interior of bowls and was produced by the use of carbon which was prevalent in north-eastern Arizona, and an iron, which was widely distributed over the remainder of the area. The designs are generally ribbon-like panels embellished with dots, zig-zags, and stepped line elements. The opening of the Developmental Pueblo period witnessed changes. New features were introduced and there was a marked expansion in the industry. Surfaces were carefully smoothed and the application of a step was introduced. A great diversity of form is shown with colour; plain grey, black on white, black on red, and brown with a brownish exterior and a slightly burnished interior. All types of vessel are decorated. There are two main groups of the light-coloured vessels ornamented with black, of which one occurs throughout the eastern part of Arizona centring about the Chaco Canyon area, and the other predominating in the west.

On the Whitewater site, stratigraphic tests show a definite progression in pottery forms and a certain sequence in the appearance of types. This is augmented by the association between ceramic styles and house remains and an indication of a certain

* Smithsonian Institution, Bureau of American Ethnology, *Bull.* 126. Archæological Remains in the Whitewater District, Eastern Arizona. Pt. 2. Artifacts and Burials. By Frank H. H. Roberts, Jr. With an appendix: Skeletal Remains from the Whitewater District, Eastern Arizona. By T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: G.P.O.) 50 cents.

time factor through the dendrochronological dating of some of the structures. The earliest type of pottery noted for the district is a form identifiable as late Modified Basket-Maker of the eastern variety—a type occurring across the plateau in western New Mexico to the San Juan and into the north-eastern San Juan basin. The second type in the series is one typical of the beginning stage of the Developmental Pueblo period through the greater part of the Anasazi province that was characterized by the Chaco cultural pattern. Afterwards, a new form appeared that gives strong evidence of Chaco influence but which seemingly comes from the area lying between the Puerco and Little Colorado Rivers —the Little Colorado style as it has been called. While this ware indicates an affinity with types found along the Little Colorado, the designs suggest a Chaco derivation. A third type of the Early Developmental Pueblo is the Kana—a black on white. Most of the ceramic developments during middle and late phases of the Whitewater occupation were an outgrowth from these three forms with some additions from the Little Colorado, the Upper Gila of New Mexico, and continued influence from the Chaco Canyon area in north-western New Mexico.

The significant feature about the pottery evidence is that it demonstrates an early south-west extension of influence from the Chaco Canyon area with a spread later toward the north-west from Little Colorado centres and towards the south-east from the Kayenta or Tusayan region—a movement contrary to that postulated by many south-western workers and tending to show that many traits appear in the Chaco that have been attributed to influence penetrating from the Little Colorado region, though they belong to the Chaco and were diffused from there towards the Little Colorado. Further, from evidence of the present material, there must have been a strong interplay of influence between the Chaco and Tularosa regions before the growth of that between Tularosa and Little Colorado.

Although the skeletal material examined by Dr. Stewart is not sufficient to give a broad view of the general characteristics of the people, certain interesting and important points emerge.

In the first place, further elaboration is given to Seltzer's view that the evidence does not justify the theory of a sweeping change in physical type during the transitional Basket-Maker-Pueblo period. This theory rests chiefly upon the unproved premise that cranial deformation among the Pueblos is accidental, but the predominance of lambdoid deformation in the Whitewater District and among the culturally related groups in New Mexico and Colorado lends force to the view that in general its use among the Pueblos was more than accidental, thus effectively masking the long-headed form of the natural skull. The evidence thus runs contrary to the generally accepted view that the beginning of the Pueblo period was marked by an infiltration of round-headed groups.

Secondly, the present group shows definite relationship to the Basket-Maker physical type as well as to other peoples having the Anasazi cultural pattern, the so-called "South West Plateau" physical type. Further, according to Dr. Stewart the 'lambdoid' type of deformation points to a relationship with peoples who occupied certain sites in the Chaco Canyon and south-western Colorado, "a feature which correlates nicely with the cultural evidence for a predominant Chaco influence in the [Whitewater] arts and industries".

FORTHCOMING EVENTS

Monday, November 18

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 1).

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Miss Harriet Wanklyn: "The Rôle of Peasant Hungary in Europe".

Tuesday, November 19

Institution of Civil Engineers (at Great George Street, S.W.1), at 1.30 p.m.—Mr. William Barnes: "Methods of Excavation Work at Home and Abroad" (Dugald Clerk Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Head of the Engineering Department of the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (November 21).

Engineering Workshop Instructor—The Principal, Twickenham Technical College, Egerton Road, Twickenham (November 23).

Assistant Mechanical Engineer for the Electrical Branch, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9346).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Technical Report, Reference W/T2: A Critical Study of the Application of Electricity to Agriculture and Horticulture. By C. A. Cameron Brown. Pp. 84. (London: British Electrical and Allied Industries Research Association.) 2*s*. net. [3010

London Shellac Research Bureau. Bulletin No. 4: Chemical Constants of Lac—Some Notes on the Acid, Saponification and Hydroxyl Values of Lac. By Dr. B. S. Gidvani and Mrs. J. M. Dobbie. Pp. 16. (London: London Shellac Research Bureau.) [411

Other Countries

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1940. Pp. 8. (Salisbury: Queen Victoria Memorial.) [2210

Colony and Protectorate of Kenya. Forest Department Annual Report, 1939. Pp. 30. (Nairobi: Government Printer.) 2*s*. [2210

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 19, 1937. iv. Meteorologiska iakttagelser i Sverige, Band 79. Pp. xi+107. 7 kr. Årsbok, 21, 1939. i. Månadsöversikt över väderlek och vattentillgång. Pp. 78. 2.50 kr. Meddelanden, Band 7, No. 6: Temperaturmätningar i Vänern och Götaälv. Av Anders Ångström och Stig Jacobson. Pp. 20+12 plates. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [2310

Smithsonian Institution: Bureau of American Ethnology. Bulletin 126: Archæological Remains in the Whitewater District, Eastern Arizona. Part 2: Artifacts and Burials. By Frank H. H. Roberts, Jr.; with an Appendix: Skeletal Remains from the Whitewater District, Eastern Arizona, by T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: Government Printing Office.) 50 cents. [2510

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 391: The Utilization of Certain Feeding Stuffs by Cattle. By E. B. Forbes, John W. Bratzler and Cyrus E. French. Pp. ii+14. (State College, Pa.: Pennsylvania State College.) [2910

Proceedings of the American Philosophical Society. Vol. 83, No. 4: Symposium on Characteristics of American Culture and its Place in General Culture. Pp. 513–588. (Philadelphia: American Philosophical Society.) 50 cents. [2910

Proceedings of the United States National Museum. Vol. 89, No. 3094: The West American *Haliotis*. By Paul Bartsch. Pp. 49–58+plates 6–8. (Washington, D.C.: Government Printing Office.) [2910

Royal Observatory, Hong Kong. Meteorological Results, 1939, prepared under the direction of C. W. Jeffries. Pp. v+144+40+6. 3 dollars. Annual Report of the Director of the Royal Observatory, Hong Kong, for the Year 1939. Pp. F8. 30 cents. (Hong Kong: Government Printers.) [2910

Report of the Kodaikanal Observatory for the Year 1939. Pp. 6. (Delhi: Manager of Publications.) 2 annas; 3*d*. [111

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Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

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THE MINISTRY OF WORKS AND BUILDINGS

IN his speech to the Trades Union Congress on October 9, Mr. Ernest Bevin stated that the Cabinet had decided against the establishment of a Ministry of Reconstruction to consider the problems of the peace and to prepare plans for meeting them. Instead, a Cabinet committee has been set up to consider post-War questions and to work out general principles for guidance. There will be many who think that Mr. Bevin did less than justice to the work of the Ministry of Reconstruction established under Dr. (now Lord) Addison in 1917. Whether we hold that the task of preparing for the future should be the task of a special Ministry of Reconstruction or, as suggested by Prof. J. H. Jones, of an Economic Reconstruction Commission, the task is clearly that of the Cabinet, and the gravest danger to be avoided is that of hasty improvisation by war-weary Ministers in control of departments that have been overburdened by the urgent tasks imposed by the War.

The appointment of Lord Reith to the new office of Minister of Works and Buildings and First Commissioner of Works is, however, indication that the Government recognizes more fully than Mr. Bevin's speech would imply the magnitude of the task which lies ahead. The general approval with which the creation of this new office was received may indeed be attributed to the assumption that its task was to be almost wholly that of reconstruction—immediate and local in bombed areas, theoretical and general as regards national replanning and rebuilding after the War. These expectations were somewhat disappointed by Mr. Attlee's statement on October 24 regarding the functions of the new Ministry, and by Lord Reith's own statement in similar terms on November 13 in the House of Lords. Wide as are the functions of the new Ministry, they do not inspire the vision of a new England of well-designed, clean and slumless towns, an architecture of public buildings and private homes justifying civic and personal pride, the wise and creative use of the new materials and the planning of communications and industrial and other building to safeguard æsthetic and health values as well as serve efficiency.

The two statements were largely confined to the war-time duties of the Ministry and the alterations in departmental responsibilities. The new Ministry will be responsible for the erection of all new civil works and buildings required by any other Government department. It will take over the whole organization of His Majesty's Office of Works, including its present responsibilities for the erection of buildings for other civil departments and for service departments, and some of the work of the Ministry of Supply, including the new buildings section of the Ordnance Factories and the approval of plans of new private factories or the extensions of existing private factories to the cost of which the Ministry of Supply is contributing. The Ministry will be responsible for the licensing of private building, and for determining the priority of proposals for rebuilding buildings damaged by air raids. By arrangement with the service departments or the Ministry of Aircraft Production it may erect on their behalf new works and buildings not of a highly specialized character, or supervise contracts for the erection of new private factories or the extension of existing private factories required for war production.

The general order of priority of building work will be laid down by the Production Council, of which the Minister will be a member, and he will be responsible for the Works and Buildings Priority

Committee. The Minister will be empowered to call for information from all departments retaining responsibility for the erection and maintenance of buildings and works of construction, including departments concerned with work carried out by or for local authorities and public utility undertakings. He will also be responsible for such control, or central purchase of building materials not at present controlled, as may be necessary. The Minister will also have the task of instituting research into such questions as the adoption of substitutes for building materials which are in short supply, or the modification of designs and specifications with a view to expedition and for ensuring that the results of past and future research are promptly communicated to all concerned. For this purpose he will make full use of the building research organization of the Department of Scientific and Industrial Research. He will be empowered to call on Departments retaining responsibility for building to satisfy him that they were making full use of the results of research in this connexion.

This statement shows that the Ministry of Works and Buildings clearly envisages the great possibilities open to the building industry, architects and town-planners; first, the control by a single authority of the production and allocation of all building resources for the period of the War; secondly, the continuance of the Ministry's control after the War so that building resources may be carefully guided in supplying a huge demand; and thirdly, the post-War amalgamation of the Ministry and the Town-Planning Section of the Ministry of Health to evolve and direct positive territorial planning policy. Even should the first of these functions absorb all the energies of the Ministry for the first year, if its powers are exercised with wisdom and foresight, many undesirable developments may be checked and much important preparatory work for reconstruction completed.

The Ministry of Works and Buildings is clearly the only right remedy for the serious difficulties which have arisen from the shortage of certain materials, plant, etc., and the even bigger difficulties in the production of building materials of the required kinds and their allocation between war expansion requirements, air raid repairs to communications, services and essential buildings, general works of maintenance, civil defence works and such other works as are made necessary by bombing. Its duties as outlined by Lord Reith falling into the three divisions, supervision, execution and research, provide the essential co-ordination of resources and should secure the full co-operation of the industries concerned.

An important memorandum recently forwarded by the Garden Cities and Town Planning Association to the Prime Minister and other ministers concerned with the use of land, outlining a practical policy with regard to bombed-out factories, rebuilding and replanning damaged areas, housing, compensation and the preservation of land for food-growing, urges that the control of war-time developments of industry or rehousing exercised by the Ministry should be through a fully qualified planning board, competent to consider and to balance all the national interests that arise in new developments. The present situation indeed stresses the importance of the principles and recommendations of the Barlow Commission, and adoption of the principle of long-range planning by the Government is a first consideration even from the point of view of the building industry alone. Indeed only by insisting on the duty of forecasting, by programmes obtained from all other departments, the total demand on the building industry at least a year ahead and preparing resources to meet those demands in the light of probable shortages of important materials, can the Ministry hope to discharge its most immediate task.

Beyond those immediate problems there must be kept in mind those broad principles which have emerged from inquiries into the distribution of the industrial population in recent years. To limit the size and density of cities, to move out congested industries to moderate-sized well-planned towns, including some new garden cities; and to replan and rebuild the central parts of old cities, with much more open and garden space and more attention to convenience and beauty, and the elimination of wasteful daily travel so far as possible—these are now practical objectives the achievement of which is even assisted by the destruction already caused by air attack.

The new Ministry may indeed offer us the first prospect of the co-ordination leading to a comprehensive far-sighted national plan of development. Mr. Attlee's statement showed that the Government is alive to the great opportunities which are offered in the reconstruction of town and country after the War. The Minister has been charged with the responsibility of consulting the departments and organizations concerned, with the view of reporting to the Cabinet the appropriate

methods and machinery for dealing with the issues involved. The relation of the Ministry of Works and Buildings to the existing machinery for statutory planning must obviously be very close. Accordingly the memorandum from the Garden Cities and Town Planning Association suggests that the best solution of the administrative problem will ultimately be the creation of a Ministry of Planning (or of Planning and Building), to absorb the functions of controlling building and of directing the statutory planning machinery, and to formulate a broad national policy for the distribution of industry which would be operated through the regional and local committees.

The memorandum also submits that the National Advisory Planning Board should consider which of the areas now subject to heavy bombardment are in themselves reasonably satisfactory from a planning point of view and not unduly congested, and which of them are so badly planned or so congested that replanning is advisable. In the former areas there should be no ban on rebuilding or repair at the earliest safe moment, subject to local architectural and planning control and given the necessity of accommodation locally and the approval of the Ministry of Works and Buildings from the point of view of the availability of materials and labour. In the unsatisfactory areas, however, it is strongly urged that wholesale expenditure on restoration or rebuilding should be deferred and the population evacuated to other areas, including those where new factories are being erected. Sir Charles Bressey, whose report on London's transport deserves fresh attention, has independently also entered a plea that no schemes of rehabilitation in bombed areas should go forward without reference to accepted principles and standards for the improvement of London's streets and buildings.

The complexities and possibilities of the problems confronting the new Ministry are indeed immense. They involve the question of evacuation, which, in respect of mothers and young children, is largely a question of the provision of suitable accommodation in the reception areas, part at least of which will involve new construction or the structural adaptation of existing premises. There is also the question of providing alternative accommodation of industries which may need to be dispersed from London and certain other large cities if the destruction of property and dislocation of transport and other public services becomes acute. This involves not merely the provision of a reserve of new factories in suitable situations but also the provision of housing accommodation for industrial workers engaged on war production or the service of the civil population, possibly involving a priority system in the smaller towns.

Moreover, not even in war-time can we neglect the control of building in agricultural areas. Sporadic or ill-considered building has already robbed the country of valuable agricultural land when alternative siting on land less valuable for food production could readily have been found. The criticism of the Select Committee on the neglect of camouflage possibilities in choosing sites could equally apply to neglect of agricultural or food production values. Moreover, some of the worst offenders have been the service departments over whose activities in respect of aerodromes, fortifications and other highly specialized work the Ministry of Works and Buildings will have no control.

Nor is it only on these grounds that there are well-founded fears as to whether the functions and powers of the new Ministry are sufficiently extensive. The work of rebuilding is indeed only a small part of the task of reconstruction awaiting us. That reconstruction will reshape many ways of life and will attack poverty and slumdom, ignorance and ill-health, the insecurities of employment, the closed doors of opportunity. It involves nothing less than the replanning of the national life, and if the Ministry of Works and Buildings is to have any real powers in planning and reconstruction, it must take over much of the present work of the Ministry of Health—especially its housing and planning departments. Besides close relations with the local authorities and with all the technical and professional bodies connected with building, the new Ministry must undertake a large task of education.

We can only hope to build a better order in any sense of the word in so far as both the population and their leaders are prepared for it. Educational work of this type is essential if our younger architects with vision and understanding are to be given the opportunity to express the possibilities of the new materials and to seize the new opportunities of serving social needs. It is equally a preliminary to securing the firm direction from the top to override anarchic interests. If the execution of such a programme of education lies outside the scope of the new Ministry, something at least of the inspiration is to be looked for from it.

RECENT BRITISH EXCAVATIONS IN EGYPT

Temples of Armant

A Preliminary Survey. By Sir Robert Mond and Oliver H. Myers; with Chapters by M. S. Drower, D. B. Harden, S. A. Huzayyin, R. E. McEuen and Mary I. C. Myers. The Text. Pp. xii+223. The Plates. Pp. vi+107 plates. (London: Egypt Exploration Society, 1940.)

EGYPTOLOGY is deeply indebted to Lady Mond for making financially possible the publication in these two fine volumes of the material obtained during the excavation of the temple sites at Armant. Much of this material is of considerable archæological and historical importance, and at the same time it comprises inscriptions, reliefs and statues, which, though for the most part fragmentary, will interest both philologists and students of Egyptian art and religion.

In the opening chapter, Mr. Myers deals with the long history of Armant, which as late as the thirteenth century A.D. was still a town of considerable size and importance. It is disappointing to have to record that with the destruction of the late Roman wall in the middle of the last century "have probably gone the last hopes of tracing the life history (as opposed to the funerary record) of Buchis" (p. 10).

A number of fragments of reliefs, once adorning the Eleventh Dynasty temple of Mentu, have been recovered (Pls. XCIV ff.). As examples of Eleventh Dynasty sculpture, several of these fragments are of great value and interest, showing as they do that some at least of the craftsmen of this period were as accomplished masters of technique and design as their predecessors in the Old Kingdom.

It might here be noted that an inscription accompanying one of the Twelfth Dynasty reliefs which Mr. Myers has unearthed suggests that the cult of the Bull of Mentu originated in the town of eṭ-Ṭūd (Pl. XCIX, 2; p. 157).

I am inclined to agree with the suggestion that the Osirid statues bearing the name of Merenptaḥ, who seems to have had some special connexion with Armant, are of Eleventh Dynasty workmanship usurped by the above-mentioned Pharaoh (Pls. XV ff.; p. 50). I find it difficult to believe, however, that the pylon relief of the procession of tribute-bearing negroes headed by a captive rhinoceros dates from the reign of Tuthmosis III (pp. 25 f.). Not only its style but also the phraseology of the accompanying inscription, and above all the occurrence of the word *Pr-ʿ3* with the meaning 'Pharaoh'—a usage not so far known before the reign of Akhenaten (p. 160)—suggest the reign of Rameses II. Mr. J. Fisher, by the way, contributes an interesting note (p. 204) on the dimensions of the captive rhinoceros which are inscribed beside the representation of it.

An exceptionally fine example of Egyptian sculpture is the fragment of a relief displaying the heads of captive Nubians and negroes (Pl. LXXXVII, 3). The account of the measures taken to preserve the colouring of this relief is most instructive (p. 23).

Archæologists will welcome Mr. S. A. Huzayyin's chapter on the flint implements (pp. 66 ff.) and will no doubt note with approval his remarks on the possibility of the survival of certain elements and aspects of Predynastic technique into historic times. A similar view was expressed by Dr. G. A. Reisner to me so long ago as 1908.

Mr. Myers deals admirably and at length with the Roman and Coptic pottery, material at one time shamefully neglected by Egyptologists (pp. 78 ff.). Pls. LIV ff. supply a valuable addition to the Corpus of Graeco-Roman-Coptic pottery in "Bucheum III", as do the two coloured plates LXXII and LXXIII, reproduced from paintings by Mrs. Myers, which exemplify the decorations on late Roman and Coptic ceramics.

Miss Drower's chapter on the inscriptions (pp. 157 ff.) deserves a special word of praise. Her translations and notes are admirable, and what she has to say on Mentu and the Hermonthite triad will be read with interest by students of Egyptian religious cults. She is particularly to be congratulated on the way in which she has tackled the important historical text inscribed on the fine, but unfortunately much broken, granite stela of Tuthmosis III. The text in question contains much matter of philological interest, including the Egyptian name for a rhinoceros—*Š3kb*.

The objects in glass, metal, wood and ivory, etc., and the beads, scarabs and amulets, are all dealt with in detail by specialists, from whose comments, as from the various registers and technical reports, much useful information is to be derived.

The photographic and other plates are excellent, clear and not overcrowded, and the indexing, without which a work of this sort loses much of its usefulness, is very thorough. Mr. Myers is indeed to be congratulated on what he has succeeded in accomplishing in these abnormal times.

A. M. Blackman.

TEXT-BOOKS OF ADVANCED MATHEMATICS

(1) Determinants and Matrices
By Dr. A. C. Aitken. Pp. vii+136.

(2) Theory of Equations
By Prof. H. W. Turnbull. Pp. xii+152.

(3) Integration
By Dr. R. P. Gillespie. Pp. viii+126.

(4) Vector Methods: Applied to Differential Geometry, Mechanics and Potential Theory
By Dr. D. E. Rutherford. Pp. viii+128.

(5) Integration of Ordinary Differential Equations
By Dr. E. L. Ince. Pp. viii+148.
(Edinburgh and London: Oliver and Boyd, 1939.) 4*s*. 6*d*. net each.

(6) Advanced Algebra
By S. Barnard and J. M. Child. Pp. x+280. (London: Macmillan and Co., Ltd., 1939.) 16*s*.

THE volumes published under the series title "University Mathematical Texts" mark a new venture in the production of English mathematical text-books. Each of these volumes deals with a single topic, the material of which could be reasonably covered in a one-term lecture course. If the further volumes which are promised maintain the standard of excellence shown by some of those under review, the success of the series ought to be assured.

(1) It is perhaps a sign of the trend of present-day mathematical thought that two of the volumes already issued deal with algebra. The theory of matrices has recently assumed a central place in mathematics. Dr. Aitken's book develops the theory from the beginning, and covers practically all the essential parts of the subject; it commences with a chapter on the algebra of matrices, and then proceeds to define determinants and develop their properties, and to discuss the theory of linear equations and linear dependence. There follows a discussion of the Cauchy and Lagrange expansions of a determinant, the theorems of Jacobi and Binet-Cauchy and their consequences, and finally a chapter on determinants of special type.

The treatment of the subject is masterly, and this work must rank as one of the best text-books on the subject in the language. It should appeal particularly to those students who find the subject difficult at a first reading. The book is well supplied with examples, which serve to clinch the theorems proved in the text, and contain many other results of importance.

(2) The subject matter of Prof. Turnbull's book is of a very different nature, for the theory of equations is one of the oldest branches of higher algebra. Prof. Turnbull's delightful account will be read with interest not only for its excellent treatment of the theory, but also for its interesting historical remarks.

After introductory chapters dealing with polynomials and rational functions, a sketch is given of Gauss's proof of the fundamental theorem of algebra, and this is followed by an account of the theory of symmetric functions. Next follows a chapter on the numerical solution of algebraic equations, and this is succeeded by an account of Descartes's rule of signs and Sturm's theorem. The remaining chapters deal with the binomial equation, cubic and quartic equations (with an introduction to canonical forms) and a brief account of the theory of elimination. The book is most attractively written, and should meet with well-deserved success.

(3) Dr. Gillespie's book on integration seems to be less happily conceived, and it is not quite clear for whom it is intended. The first part deals with the formal technique of evaluation and transformation of simple and double integrals, and with the theorems of Green and Stokes, based on an intuitive definition of a definite integral as an area, while the latter part deals with the rigorous theory of the Riemann simple and double integrals, and at one point at least appeals to the theory of measure. The book thus falls between two stools; the first part is not sufficiently rigorous for an honours student, while the later part is too difficult for those merely reading for a pass degree.

(4) Dr. Rutherford's book gives an excellent elementary account of the algebra of vectors and of its application to differential geometry, dynamics and potential theory. The treatment is clear and concise, and the volume is remarkable for the wide range of topics treated in a small compass. It should prove a useful text-book on a theory which is now widely used in many different branches of mathematics.

(5) Dr. Ince's book deals concisely with the types of ordinary differential equations which are commonly studied in a university course. It follows the standard order of treatment, dealing first with the various soluble types of equations of the first order and then with equations of higher orders. The latter part of the book deals with linear equations, with constant coefficients and with the solution of equations in series, particular reference

being made to the hypergeometric equation and the equations of Legendre and Bessel. We should have liked to see a description of Heaviside's method for solving differential equations with constant coefficients included, as this useful method is neglected by most of the current text-books.

All these volumes are well produced and clearly printed. Their publication at a modest price will, we think, be widely welcomed.

(6) The other volume under review is of a very different kind. "Advanced Algebra" deals with such widely divergent topics as probability, diophantine equations, homographic transformations, and the elements of the theory of functions. The result is a book which is full of interesting things, but which is lacking in the unity of a text-book confined to a single topic. The first chapter deals, in an attractive way, with the algebra underlying the geometrical theory of homographic transformation, cross-ratio and involution; it is a well-conceived piece of work, but the analyst will probably be puzzled by the phrase "any point at infinity is the z-plane". Next follows an account of the resultant of two quadratic polynomials, and of graphs of functions of the type $(ax^2 + 2bx + c)/(a'x^2 + 2b'x + c')$. The proof (on pp. 21, 22) that the resultant of two real quadratics is negative if, and only if, the roots of the two corresponding equations are real and separate from each other contains an error, but the reader will easily construct a valid proof for himself. The next four chapters deal with double series, uniform convergence, and the exponential and logarithmic functions of a complex variable, matters now usually regarded as belonging to analysis. Chapters on elimination and probability follow. The next, and in many ways the most interesting, part of the book deals with the elementary parts of the theory of numbers, continued fractions and diophantine equations. There is a very readable account of the theory of quadratic residues and Gauss's law of quadratic reciprocity, leading up to a discussion of primitive roots, of the expression of numbers as the sum of two or four integral squares, of methods for the factorization of large numbers, and of the theory of the binomial equation. A chapter is devoted to the solution in integers of equations of the form $x^2 + Ny^2 = M$. This is marred by an unfortunate mistake at the outset, where it is asserted that if (x, y) and (x_1, y_1) are two pairs of relatively prime integers such that $x^2+Ny^2=M_1M_2$, $x_1^2+Ny_1^2=M_1$, then the equation $x^2+Ny^2=M_2$ has integral solutions if M_1 is an odd prime, a power of an odd prime or twice such a number; this theorem is not necessarily true if M_1 is an odd prime power, as is shown by the example $6^2+18{\cdot}5^2=81{\cdot}6$, $3^2+18{\cdot}2^2=81$, $x^2+18y^2\neq 6$ for any integral x, y. The book concludes with an interesting account of infinite continued fractions, an introduction to the theory of invariants, and an account of linear transformations.

There are numerous exercises in the text and a collection of miscellaneous examples at the end. The production is up to the high standard we expect from its publishers.

J. A. Todd.

THE CHEMICAL LECTURE BENCH

Lecture Demonstrations in General Chemistry
By Prof. Paul Arthur. (International Chemical Series.) Pp. xvi + 455. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26s.

THE author of this useful manual rightly states that: "The task of the lecture demonstrator is unusually specialized, requiring, as it does, something of showmanship without submergence of educational objectives. Perhaps no other branch of teaching requires such nicety of balance and such care in presentation". The student who sees what appear to be simple experiments rapidly and successfully performed does not appreciate the long and difficult apprenticeship which makes such results possible, and the work of generations of university teachers which is embodied in a course of lecture experiments. It is only when he is called upon to perform these experiments himself, when he has usually to depend on his own resources, that these facts become familiar to the teacher. The number of really useful books to which he can then turn for guidance is quite small and any addition to this field of literature is, therefore, welcome. The keen lecturer, again, is always on the look-out for new experiments, and will be interested in such books.

The present work is noteworthy in its scope, which includes physical chemistry and organic chemistry as well as the usual experiments for the course in inorganic chemistry, and for its inclusion of many new experiments, several of these being collected from the *Journal of Chemical Education* and *School Science* and *Mathematics* (references to papers in these being given). The author has had experience in such work and the text shows that he fully appreciates the need for careful detail in the descriptions. Such detail is, in fact, essential, and as it can never be given in the space available in text-books, such a book as this is absolutely necessary as a supplement to these.

A large number of apparently simple experiments fail because some small detail has been neglected, and although some lecturers make a point of suggesting possible causes of failure and even think this has an educational value, they rarely hit on the real cause, and a succession of 'damp squibs' leads the student to doubt the validity of the statement that chemistry is an exact science. Lecture experiments should succeed if they are to fulfil their purpose. The causes of such failures are frequently stated in the book.

The ground covered is so wide that a detailed account of the book cannot be given. It may be said, however, that the inorganic chemistry section is well covered, although some excellent experiments are missing from it. The section on organic chemistry is brief and will require supplementing in a detailed course. The experiments on physical chemistry are particularly noteworthy, and there are many new demonstrations in this field. The physical properties of gases, solutions and colloids, energy and chemical change (including some good experiments on photo-chemistry), radioactivity, the ionic theory, electrochemistry and colloid chemistry are dealt with.

The author claims six major features for his book : wide scope, references to literature, accessibility, the selection of easily visible experiments which may be completed in a lecture period, suggestions as to the principles illustrated by each experiment, and adaptability to standard text-books. These claims are justified, and everyone who has to perform lecture experiments in chemistry will find the book useful and helpful.

THE SCIENCE OF ANIMAL BREEDING

Animal Breeding

By Prof. Laurence M. Winters. Third edition. Pp. viii + 316. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 21*s*. net.

ANIMAL breeding, says Prof. Winters, is the art of improving animals. As such, it depends for success on a skill of hand and eye which can scarcely be acquired from books, and indeed, in this third edition of his book, Prof. Winters is not so much concerned with the art as with giving students an up-to-date account of the science. His pages offer the younger generation of breeders and extension workers the gift of science to animal breeding—the organized knowledge which enlarges the scope and power of the enterprising craftsman. That the author now addresses himself to students involves an interesting transition, since the progressive breeder for whom the first edition was written has been deserted for the student whose background of fundamental sciences renders many modern investigations more intelligible.

Beginning with historical glimpses of the development of domestic animals, the book continues with the anatomy of the genitalia, the physiology of the breeding cycle, the cytology of the gonads, and the technique of artificial insemination. Following this selection of applied sciences and at greater length is an exposition of inheritance which follows orthodox lines. Mendel's laws are explained and illustrated with some well-known simple examples, and then the more complicated genetic situations presented by selection and breeding for economic characters are considered. The choice of the most significant items from an enormous mass of literature is difficult, and it is scarcely to be expected that any two authors would agree on the way to do it. Experienced readers may therefore think that some subjects in which they are interested, such as adaptation to environment, the creation of new breeds, or progeny testing, have received too little attention for a text-book, and that others, such as selection and breeding systems, have not been considered sufficiently from the point of view of the breeder whose difficulties will ultimately have to be met by the student. The author's wide range of experimental studies with their practical background well qualifies him as a guide for students, so that it seems a pity he has not dealt more fully with improvement as the breeder sees it.

To enunciate a number of good scientific reasons for following a certain line of action is one thing ; to decide which of the multifarious and often conflicting considerations that arise in practice should receive greatest weight is quite another ; and ignorance of the latter often breeds distrust of the former. Another feature that might be criticized is the use of illustrations from the 1924 edition, for example, Figs. 69 and 117, which are rather poor by 1940 standards. Whatever may be said of the details of his treatment, no one can complain that Prof. Winters is satisfied with the present rate of improvement in livestock. He wants shows to be occasions for instruction rather than carnivals ; record of performance tests made and used ; artificial insemination, cross-breeding and heterosis exploited. In short, he wants progress to be hastened by all available methods, a desire which all his readers will share.

H. P. DONALD.

The Principles of Electric Power Transmission by Alternating Currents

By H. Waddicor. Fourth edition, revised. Pp. xxi+458. (London: Chapman and Hall, Ltd., 1939.) 21*s*. net.

THAT this well-known and valued text-book, first published in 1928, has appeared in its fourth edition is a remarkable achievement and bears testimony to the author's ability. The principal alterations introduced in the present edition refer to underground cables, and recent extensive research and development work in connexion with the thermal properties of cables is set out in the revised Chapter x. There is an excellent bibliography with up-to-date references. For some obscure reason the index is not so complete as could be wished; for example, the name of J. A. Fleming appears in the text but not in the index.

When dealing with the theory of electrically long lines, the author evidently prefers the term "line angle" for the complex quantity $\sqrt{ZY}$, rather than the "propagation constant" commonly used in telecommunication practice and by other writers on power transmission. Students at universities and technical colleges, to whom the author refers in the preface to his book, are likely to desire a wider and more generalized outlook on transmission problems and theory. In view of this, it is hoped that, in a future edition, at least mention may be made of attenuation, wave velocity and the conditions underlying reflection in long lines. Recent developments in the protection of high-voltage transformer windings (non-resonating) are mentioned but no details given.

The book is well illustrated and beautifully printed, and in the reviewer's experience is known to suit the requirements of students of power engineering, and for such the book is recommended without reserve.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 35: Aluminium. Teil A, Lief. 6: Legierung von Aluminium mit Mangan bis Rhenium. Pp. 887–1110+xxii. (Berlin: Verlag Chemie, G.m.b.H., 1939.) 27.75 gold marks.

A COMPREHENSIVE account of the composition, chemical and physical properties of the alloys of aluminium with manganese, nickel, cobalt, silver, gold, platinum and various other metals is included in the part of "Gmelins Handbuch" under notice. The views of various authorities on the composition of the solid phases in the system Al–Mn are contradictory and are set forth in a series of diagrams for comparison. Four intermetallic compounds, Al_6Mn, Al_4Mn, Al_3Mn and AlMn, have been identified, of which only the last-mentioned has a congruent melting point at 1287° C. These alloys are not affected by dry air, but disintegrate when the air is moist. Aluminium mixes with nickel in all proportions in the liquid state and a compound, AlNi, separates at 1640° C. The slow disintegration of these alloys in moist air is accelerated by the presence of other intermetallic compounds.

Much space is given to the alloys with silver, although there is still some uncertainty about the composition of the solid phases in alloys containing more than 14 per cent of aluminium. Whereas the solubility of aluminium in silver varies between 5·1 per cent at 200° C. and 6·52 per cent at 500° C., that of silver in aluminium increases from 0·75 per cent to about 48 per cent in the same temperature range. The intermetallic compound Ag_3Al melts at 779° C. Several ternary and quaternary alloys are also discussed in this number, which is packed with detail and well illustrated with diagrams.

Direct and Alternating Currents

Theory and Machinery. By E. A. Loew. Second edition. Pp. xv+730. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s*.

THE second edition of this text-book is a creditable effort on the part of the author to cover, in a single volume of 730 pages, the extensive field embracing the theory and applications of direct and alternating current circuits, machinery and apparatus. Numerous examples are given to illustrate the principles of direct current and alternating current machinery and in addition there is a selection of problems, at the end of most chapters, which are suitable for tutorial classes. The treatment of the subject is of an introductory nature, but, although not sufficiently advanced to suit the requirements of a degree course syllabus in a British university, this book would assist students attending a course of lectures on a general survey of the subject of D.C. and A.C. machinery and apparatus. Throughout the book there is evidence of the restriction, imposed by lack of space, on the treatment of the problems involved and this offsets much of the gain in having the whole subject in a single volume.

The final chapter, on thermionic apparatus, while commendable as a brief and interesting survey, would have been much enhanced in value had the author included worked examples and a selection of problems.

Direct-Current Machinery

By Prof. Hempstead S. Bull. Pp. vi+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

A STUDENT having limited time for the study of the principles of direct current machinery will find this book useful as a general survey of the subject. The treatment is elementary but, so far as it goes, is satisfactory and well presented in the 318 pages and adequate illustrations.

As there is little matter not to be found in existing text-books this is a disappointing feature and renders the book of little use to the advanced student or designer. Each chapter is provided with a useful bibliography, mainly American, and a set of problems.

The importance of the direct current motor has resulted in notable advances in the available information about heating and improvements in the design and construction of modern machines. The book contains little information about temperature rise and the disposal of heat generated in the active materials, and therefore cannot be regarded as an up-to-date treatise.

THE VITAMIN B COMPLEX IN NORMAL NUTRITION*

By Prof. C. A. Elvehjem,
University of Wisconsin

During the last decade, distinct advances have been made in our knowledge of the chemistry and physiology of vitamins. Perhaps some of the most interesting observations have been made in the field of the vitamin B complex. There may be two reasons for this situation. First, the chemical structure of the water-soluble vitamins is somewhat less complicated than that of the fat-soluble vitamins. Vitamin B_1 was first synthesized in 1936, and we have seen an average of one B vitamin synthesized a year since that time. Secondly, at least three of the B vitamins have found their physiological function as prosthetic groups of enzymes in very important enzyme systems. The work on the relation of these vitamins to metabolism has not only aided us in understanding the function of the vitamins, but in many cases it has also helped us to understand the intricacies of metabolism itself.

How can some of the newer information about the B vitamins be used to improve public health ? We certainly have a new problem to consider in connexion with the proper use of synthetic vitamins. This is especially true in the case of the B complex, since we now have five factors available in synthetic form. Each year we see a tremendous increase in the promotion of commercial vitamin preparations containing the purified components. Does this mean merely a temporary enthusiasm because of the availability of these synthetic compounds, or does it mean a definite need for the addition of some of these factors to our regular diets ? There are certain principles which should be kept in mind regardless of whether we are dealing with vitamins as a group or with specific components.

First, vitamins should be obtained from natural foods if possible. Generally they are cheaper, more palatable, and in better balance with other factors when taken in this form. Those individuals who enjoy normal health may wonder why anyone would expect to get vitamins from any source other than his food. However, from the number of inquiries made regularly concerning the use of concentrates, it is apparent that a relatively large percentage of people are not convinced that they get adequate vitamins from natural foods. If we are to accept the above principle, we must recognize that the distribution of the individual factors in foods and the requirement of each factor must be established as rapidly as possible. This is a large assignment, but with the continual changes taking place in our available foods as well as in the types of foods consumed, we can only hope for complete dietaries if we know how these changes affect our vitamin intake. Of course, one may say that the ideal way to combat this situation is to return to the use of less-refined foods and use more of the crude products familiar to our forefathers. Some progress in this direction may be made through educational programmes ; but it would be just as difficult to return to the diets used by our forefathers as it would be to return to the use of less-refined foods and use more of the crude products familiar to our forefathers. Some progress in this direction may be made through educational programmes, but it would be just as difficult to return to the diets used by our forefathers as it would be to return to the use of the horse and trap. During the past fifty years our environment has become limited to the grocery store and the chemist's shop. Our natural foods are packaged and devitalized and the vital elements are concentrated and sold in the chemist's shop. How are we to know what to buy from the grocer and what we should get from the chemist ?

The difficulties encountered in obtaining the above facts are obvious to many of us. There is inadequate information concerning the vitamin content of foods actually consumed, and human requirements are not well established. Many of us in working on nutrition have been busy showing pictures of deficiencies in experimental animals rather than dealing with the more fundamental problems. In other words, we have been more interested in the methods used in reaching our goal than in our destination. Another imprint which animal work has left upon us relates to the glorification of certain foods as important sources of specific vitamins. The nutrition worker in his haste to make concentrates usually assays only a few foods, and if he finds one that is fairly rich, this food becomes the recognized source of this factor, while actually other foods may quantitatively be a more important source in the diet.

Most workers agree that the daily requirement of thiamin is 1–2 mgm. or 300–600 I.U. a day. It is not impossible to plan a diet which supplies this amount, but it is not a simple task. Foods that are good sources of thiamin are limited largely

* Substance of a paper presented on September 17 at the Bicentennial Conference, University of Pennsylvania.

to beans, peanuts, oatmeal, and pork products. Stiebling and Phipard in an extensive survey found the daily thiamin intake in all the groups studied to be more than 240 I.U. This figure was based on literature values for the food consumed, and it should be emphasized that loss due to cooking of the food was not taken into consideration. Baker *et al.* have concluded that the best-fed English population, while getting twice as much thiamin as people in the low-income group, consume less thiamin than the parish poor of the eighteenth and nineteenth century.

The reason for this low thiamin intake is, of course, obvious. According to Joliffe, cereals supplied 32 per cent of our calories in 1840 and only 24–25 per cent to-day. The flour used in 1840 contained 75 per cent of the original vitamin B_1 and to-day white flour contains only about 10 per cent of the original vitamin. The *per capita* consumption of sugar has increased from 8 lb. to more than 100 lb. Cereals and sugars comprise about 50 per cent of our diet. Thus a 50 per cent fraction of the calories which in the diet of 1840 provided 600 I.U. has been replaced by one furnishing but 50 I.U. This large consumption of devitalized energy foods may be more serious than we realize, but so far as vitamin B_1 is concerned the situation is not too difficult. The problem merely centres around the vitamin B_1 content of the remaining 50 per cent of the diet. Many people feel that the use of white flour is the cause of many of our nutritional ills. Again limiting the discussion to vitamin B_1, I see no objection to the use of white flour or products made from white flour provided we recognize its limitations and compensate for the decreased intake of vitamin B_1 by other foods. A pork sandwich made with white bread may supply more vitamin B_1 than a jelly sandwich made with whole wheat bread. The situation may be more serious in areas where supplementary foods are not available, and thus any attempt to increase the vitamin B_1 content of bread should be welcome by anyone interested in nutrition.

The daily requirement for riboflavin is also about 1–2 mgm. a day; but it is not difficult to obtain this amount from an average diet containing milk, vegetables and meat. Only 10 gm. of dry liver, equivalent to 2 ounces of fresh liver or a pint of milk, will supply the daily requirement. Cereals are extremely low, and any diet high in sugar and refined cereals and low in milk and animal tissues is likely to be deficient in riboflavin. Due to the availability of the bacteriological assay method, which is a great improvement over the time-consuming assays, greater progress is being made both in regard to the incidence of riboflavin deficiency and the distribution of this factor in a greater variety of foods. The incidence of riboflavin deficiency may be greater than was at first realized.

It is quite obvious that some people have had difficulty in getting a sufficient quantity of nicotinic acid from their regular food supply. Let us assume that the daily human requirement for nicotinic acid is 10 mgm. In order to get this amount one would have to eat about 2 lb. of corn meal, which is, of course, impossible. This may be an extreme example, but very many of our foods contain between 2 and 10 mgm. per 100 gm. on the dry basis, which means that we would need anywhere from 1 lb. to $1\frac{1}{4}$ lb. of these foods to supply the daily requirement. The fact remains that the only excellent sources of nicotinic acid are animal tissues, yeast, and perhaps certain vegetable materials. The original thesis of Dr. Goldberger, that a small piece of lean meat may determine the incidence of pellagra, has not changed in spite of all the newer information. The determination of the nicotinic acid content of foods has been limited largely to assays with dogs; but within the past six months chemical methods have been developed which appear to be satisfactory.

The vitamin B_6 content of foods is not clearly established, due to difficulties in the assay procedures. The existence of this factor grew out of experimental work with rats in attempts to produce a pellagrous condition similar to that observed in humans. The cure or prevention of the acrodynia in rats has been used for assay purposes; but a complicating factor enters the picture, since fats high in linoleic acid will cure the acrodynia about as rapidly as vitamin B_6. During the past year we have developed an assay procedure which is based upon growth rather than the prevention of dermatitis, and we feel that rather accurate values can be obtained by this method. For example, we have found kidney to contain 25 γ, liver 10–20 γ, and pork ham 26 γ per gram dry material. However, extensive assays are required before we can actually calculate the vitamin B_6 intake on different diets.

We are somewhat more fortunate in the case of the distribution of pantothenic acid in foods, since both the chick assay and the improved bacteriological method give quite definite values. However, we know very little about the human requirement for pantothenic acid. In fact we obtain rather peculiar results if we attempt to study the amount needed by rats. 25 μ gm. per day may suffice if all the other members of the B complex are supplied; but in the absence of certain members increasing rates of growth may be obtained by raising the intake from 25 γ to levels of 150 γ per day.

If we have difficulties with the first five members of the B complex, which are now fairly well known, one can imagine the problems encountered with the newer ones such as factor *W*, the anti-grey hair factor, and several others the existence of which has been established through studies with dogs and chicks. We may have the advantage that in many cases a food rich in one member of the B complex may also carry appreciable quantities of the other factors. However, this generalization cannot be carried very far. Thus cereals may be a fair source of thiamin and pantothenic acid, but a very poor source of riboflavin, nicotinic acid, and probably vitamin B_6. Vegetables are a good source of riboflavin but low in thiamin and pantothenic acid. Liver is an excellent source of most of the B vitamins, but is rather low in thiamin. Even milk, which supplies adequate amounts of all the factors when used as the sole article of diet, becomes limited in thiamin and nicotinic acid when diluted with inert energy foods. We are, of course, very fortunate that while we are designing our diets some of the unknown factors are thrown in without our knowledge.

The second principle which we should consider is that concentrated forms of vitamins may be used effectively under many conditions, but there is no virtue in using such preparations merely because the vitamin is present in concentrated form. In other words, one gram of a product containing 100 units of a vitamin may be no more valuable than 100 grams of food containing 1 unit per gram. In most cases the 100 grams of food would be much better, since it might contain 100 units of several different factors.

Concentrates, of course, have a very definite place in clinical medicine, and in cases of emergency the pure crystalline synthetic vitamin may be even more valuable than the concentrates. There are many valuable concentrates on the market, and these may be very valuable for patients on restricted diets. Often foods supposedly rich in certain vitamins have been used as a source of these factors without consideration of the digestibility and irritating effect of these bulky foods.

So far as we know, the synthetic forms of the B vitamins show the same biological activity as the naturally occurring forms. We know that vitamin B_1 must be converted to cocarboxylase, riboflavin to several different respiratory enzymes, and nicotinic acid to coenzymes I and II before these vitamins can function; but apparently the body is able to build these compounds if the vitamin precursors are supplied.

There is much that can be said about the misuse of this form of diet therapy, but there is one point worthy of emphasis. There is an undue effort to get the vitamin in concentrated form. If a product containing 10,000 units per gram is good, then one that contains 1,000,000 units must be 100 times better. Thus the manufacturer takes a material like yeast, extracts, adsorbs, elutes, precipitates, etc., until he gets a small amount of material very rich, let us say, in thiamin, but of necessity lacking in most of the other factors originally present in yeast. The other factors have not only been lost, but the expense of all these manipulations has also increased the price of the vitamin that is left out of all proportion to its original cost. We are beginning to recognize that nutritional deficiencies are apt to be multiple, and if a person has lived on a diet low enough in nicotinic acid to produce pellagra, it is also likely to be low in vitamin B_1, riboflavin, vitamin B_6, and perhaps others.

For many years residues from liver extract after the removal of the pernicious anæmia factor were completely ignored so far as nutritional values were concerned. More recently its value as a source of the B complex has been recognized; but even now attempts are made to sell fractions from the material on its riboflavin content or its pantothenic acid content. Liver extract is an excellent source of practically all the B vitamins except vitamin B_1. I hope someone can convince the commercial laboratories to leave this material at least partially intact because it still contains several unrecognized factors.

This brings us to the question of mixing natural concentrates and synthetic vitamins. Certainly in many cases this practice is objectionable, but in the case of related factors it may have some value. If we have a concentrate containing a combination of B vitamins and it is especially low in one of the components, the proper ratio may be restored by using a synthetic product. In fact, so long as there are unknown vitamins it may be well to include a certain amount of a natural product. One thing we must watch out for is the introduction of one vitamin out of all proportion to the others merely because this particular one happens to be relatively cheap. Often a commercial preparation is not compounded on the basis of the relative requirements of the individual vitamins but on the basis of the availability and cost of the component vitamins. However, I believe that many of these difficulties will be remedied as soon as nutrition workers make the facts available.

We have already mentioned that it may be difficult to get 1 mgm. of thiamin from our daily food supply; but there is no difficulty in supplying a patient 50 mgm. from a bottle of thiamin. I have no argument with a physician who can prove that he obtains some beneficial effect from massive doses of thiamin, riboflavin, nicotinic acid, etc.,

but from a nutritional point of view, such massive therapy means pure waste of material.

We now come to the question of adding vitamins directly to foods, or the question of fortification. The third principle which I should like to mention is that there is no fundamental objection to the addition of synthetic vitamins to food materials. We have accepted the addition of salt to our foods, and in this specific relationship I see no difference between the addition of sodium chloride or iodide and, let us say, thiamin. The addition of synthetic vitamins may be cheaper, less objectionable to our taste, and more easily controlled than relying upon specific foods or concentrates.

Most authorities agree that the fortification of milk with vitamin D is a logical procedure, and through this means many children have been protected against rickets with no extra cost. In the case of nicotinic acid, the daily requirement costs 3 cents as nicotinic acid and at least 10 cents and more in the case of almost any food you wish to buy. Surely this is a question worth considering when pellagra is an economic disease. Workers who had tried adding natural concentrates to foods, such as flour, find that even those prepared with a minimum of colour, odour and flavour are quite unsatisfactory. Certainly the addition of synthetic vitamins to foods will ensure a more uniform product than even Nature itself can produce. Dr. Roberts has suggested that the chief danger in fortification of foods is that it might tend to give a false sense of confidence that all the deficiencies of refined foods have been overcome. Surely the standardization of the amount of one vitamin in one food cannot give us false confidence any more than the standardization of the fat content of milk, which has been controlled by law for many years.

This does not mean that we are ready for the fortification of foods—there are many difficulties. I have mentioned the advantages merely because they are generally overlooked. However, it is rather amusing that many more objections are raised when a commercial company wants to add a vitamin to a food than when new processing methods are introduced which are known to be destructive to the vitamins. The difficulties encountered in fortification are so interrelated that it is difficult to know at what part of the cycle to start the discussion. Perhaps it is best to recognize first that the processing of foods removes more than one vitamin. Thus the addition of a single crystalline factor only partially restores the original value of any food. In the case of pellagra the diet is deficient not only in nicotinic acid but also in thiamin, riboflavin, probably other members of the B complex, etc. The ideal method of preventing pellagra would be to increase the meat and milk consumption, but if this is economically impossible, I see no objection to at least studying the possibility of some sort of fortification. Dr. Spies has pointed out that the use of nicotinic acid alone may lead to the development of more serious conditions, but why not also study the possibility of using other vitamins as well ? If we want to object to studies of this kind, we could go one step further and ask, why improve nutrition at all ? If you do, people will only live long enough to die of old age.

I hope you do not misunderstand me and think that I am promoting the fortification of foods ; I am merely trying to counteract some of the dogmatic statements that have been made and to present both sides of the subject. It is just as easy to demonstrate the difficulties encountered by animal experiments as it is in the field.

At the present time any attempt to add the several vitamins which are apparently necessary would merely increase the cost of the foods and move them farther than ever from the reach of the population group needing them most. The most logical approach appears to be controlled vitamin content of foods. Let us train the farmer that the vitamin content of his product determines to some extent the value of his product. Perhaps the geneticist could be induced to breed new crops for their vitamin content rather than for their yield of dry matter ; and perhaps some day we may educate the entire public to use the animal carcase in such a way as to utilize the vitamins present to the greatest advantage.

If industry removes too much of the vitamins during processing, some sort of restoration should be practised. This does not mean that each industry should try to make a complete food out of each of its products. We are still interested in a large variety of foods, some being consumed merely because we like them ; but when the final accounting is made we should have an adequate supply of all the factors. Each component of our diet should carry its fair share of the vitamin burden. Returning to our friend white flour, it apparently does not carry its share of vitamin B_1. However, from the interest shown in this problem it should soon be able to hold its own in the combat. A greater part of the original seed may be left in the flour, certain concentrates may be added, synthetic thiamin may be added, or a yeast especially high in thiamin may be used for making the bread. Further experimental work will help solve the problems, although as time goes on more difficulties will arise ; but if the agriculturist, the processor, the medical man, and the man in charge of control work will work hand in hand for the sake of improved health, deficiency diseases should be reduced to a minimum.

CULTURAL UNITY IN THE AMERICAS

SHORTLY after the Pan-American Conference in Havana last summer, Mr. Roosevelt was reported to have made a statement in which he said that the embargo then recently placed on certain exports from America was to be regarded as an American defence measure, following upon the spiritual unity which had been established in the Americas by that meeting of representatives of the American Republics. While pan-American unity thus appeared to have been held by the President of the United States as more of an accomplished fact than ever before, there were other observers, well acquainted with conditions in the Latin Americas, who did not share his optimistic view of the possibilities of securing co-operation from Central and South America in any and every action which the United States might elect to take in the defence of the western hemisphere against the aggression of non-American, or in other words against the Axis, powers. One well-informed writer, indeed, went so far as to say of the Latin Americas : "They are not interested in fighting for democracy *per se*, or for the integrity of the hemisphere as Washington sees it."

It was in fact then suggested that the attitude of the Latin States was one of watching and waiting for the turn of events in the Old World before committing themselves definitely in overt action which would define more precisely their policy in relation to the belligerent powers.

On the British side, the re-election of Mr. Roosevelt as President for a third term of office has ensured the continuance of the 'good neighbour' policy in the relations between the United States and the peoples to the centre and south. On the other side the result of the presidential election as a substantial check to those in the States who advocate a defensive policy which ends at Panama, as well as the course of recent events, in the theatre of war, while undoubtedly favourable to Mr. Roosevelt's aim to mould the Americas into a united whole, may equally well confirm the Latin Republics, at any rate for a time, in a further period of opportunist watchfulness. If the aim of the Axis powers is to embroil America and thus weaken her capacity to assist Great Britain, the attack on the Americas, owing to the development of the European situation, can come, if it is immediate, only from Japan. For the moment, the Nazi threat to South America, directed from Africa, is in abeyance. Japan must strike first at the United States, and it might well seem to the Latin peoples of America that their interests can wait on the outcome of this contest without detriment. On the other hand if, as Mr. Roosevelt claims, the movement towards unity is more deeply rooted than in political expediency, and springs from a fundamental spiritual principle to which all the peoples of the Americas equally feel themselves irrevocably pledged, the prospect of a western hemisphere united against any aggressor who threatens their liberty of thought and action is by no means so indeterminate as Mr. Roosevelt's critics would have us believe.

No close union between peoples can last for any length of time if it is based entirely on political expediency. It crumbles as the reason which called it into being fades into the background. If the tie is to endure it must be woven of that idealistic community of interests and outlook which is drawn from a common heritage and from common elements in the culture of those whom it is sought to unite. At first sight it may seem that such common elements are to seek in the ways of life of the peoples of the Americas. If the relatively negligible influence of the Italian immigrant population of the United States be ignored, and the by no means entirely negligible effect of German and British elements in Central and South America be set aside in this connexion, as it may, the cultural history and social environment of the peoples of America north of Mexico is almost entirely derivative from Northern and Central Europe, while those of Central and South America are drawn from Southern Europe, their source the cradle of Latin civilization. On broad lines the differences which mark these two sources of the American peoples and civilizations may be summed up in the statement that, while one was in religion and sentiment Roman Catholic, the other has been drawn predominantly from members of the Protestant forms of the Christian faith with a bias towards the Calvinistic. The implications of this distinction and the cultural differentiations which are in fact found in association with the two forms of the Christian faith have been further emphasized, not to say exaggerated, in the development to which they have been subjected in a period of comparative isolation from outside, and more especially European influence, since the earlier migrations of the sixteenth and seventeenth centuries. If North America has received a large influx of immigrants in the later nineteenth century, it has speedily assimilated them to its own pattern, while Central and South America, ever since the days of the Conquistadores, have moved away from their European origins by approximation to indigenous forms of culture and belief, thus still

further widening the gap in cultures and outlook which originally marked them off from the North.

This differentiation is most readily perceptible in the lower strata of the Latin population, in which the effect of miscegenation with the indigenes is most to be remarked. Among them culture and religious belief have assimilated closely to native types under the influence of social and geographical environment. So true is this that in Mexico, for example, native elements grafted on to Roman Catholicism have evolved a synthetic form of religion in which pagan and Christian elements are inextricably mingled, but none the less combine to form a whole which completely satisfies the emotional and social needs of the population.

It is a common, but by no means inexcusable, misconception, which regards the Latin American Republics as one in culture and character. The variation between them is considerable, depending to no small degree on the extent and character of their assimilations to the indigenous population. So strongly marked indeed was this differentiation that when Bolivar, the great liberator of South America at the beginning of the nineteenth century, endeavoured to form a federation of the three States of Venezuela, Colombia and Ecuador, he failed owing to differences in outlook and social and religious habit of mind. These same differences, it is to be noted, still persist as marking off the peoples of these States one from another. A further source of misconception arises from the fact that the Portuguese origin of Brazilian culture, with all its implications, is not given its full weight. Portuguese settlers in Brazil, even more than the noble Spanish settlers in the Argentine, who are largely responsible for social conditions in that State to-day, endeavoured to reproduce in their new South American home the conditions which ruled on their ancestral lands in Portugal, recreating the distinctive type of large land holdings or *fondas* to which they had been accustomed. Further, they brought with them a readiness, derived from their racial history and custom, to overlook the colour line in their matrimonial alliances, both temporary and permanent. The Brazilian population consequently has a high percentage of admixture of both indigenous Indian and negro slave blood. It affords a strong argument in support of those who regard artistic efflorescence as one result of crossing with a negro strain. Since the South and Central American Republics broke away from European influence in the last generation and began to develop upon national lines in the arts, Brazil more than any other has forged ahead, especially in music and in the development of a literature of its own.

It is neither possible nor necessary here to enter more fully into a description of the qualities and characteristics which give each and every one of the republics of Central and South America an individuality all its own over and above the very generalized and much modified heritage of a Latin form of civilization. Enough has been said, however, to show some of the difficulties which confront any endeavour to secure a close co-operation with the North destined to survive anything more than the urge of an immediate and insistent peril. The President of the United States, in his call to the American Republics to co-operation, relies upon the devotion of all to the cause of liberty and their determination to preserve the freedom of the individual in thought and action. Yet cynical observers have admitted a doubt whether to the South American liberty means more than the right to revolution in order to resolve a situation to which democracy would put an end by resort to the polling booth.

It is clear that if any measure of that closer co-operation of the American Republics desired by President Roosevelt is to be attained, it will demand a great deal of give and take, and can be based only upon mutual understanding of the different ways in which the two groups of peoples react and have reacted to the stimuli of a developing civilization. This is fully realized among certain sections of opinion in the United States, among whom a movement has been in progress since 1936 for fostering study and understanding of the culture of peoples outside the United States. One of the results of this movement has been the holding of symposia, of which the first, which took place in 1939, was devoted to the culture of the peoples of Central and South America. In a report of this symposium published recently*, distinguished authorities have surveyed the recent cultural development and in some instances the cultural history of the more important States. The Argentine, unfortunately, was not represented. Without entering into detailed discussion, it may be said that, as a whole, the contributions emphasize not merely the differentiations to which reference has been made above, but also the strong individuality in intellectual life and social consciousness which recently has come into being and shows a healthy development in the majority of these States. If the future existence of the Americas depends upon co-operation, it is safe to predict that the extent of the contribution of that union to world order will be in direct ratio to the measure in which it will have been found possible to preserve the cultural individuality of its units.

* Concerning Latin American Culture: Papers read at Byrdcliffe, Woodstock, New York, August 1939. Edited by Charles C. Griffin. (Published for the National Committee of the United States of America on International Intellectual Co-operation.) Pp. xiv+234. (New York: Columbia University Press; London: Oxford University Press, 1940.) 13*s*. 6*d*. net.

THE RUMANIAN EARTHQUAKE OF NOVEMBER 10

By Ernest Tillotson

On October 22, at about 8.30 a.m. local time, a strong earthquake with epicentre probably near Barlag shook a considerable area in Rumania (see Nature, November 9, p. 615). In Bucharest it cracked buildings, throwing some people out of bed, also overturning movable objects. In one hotel it threw a breakfast tray fully loaded from a table to the ground. By radio and special editions of the newspapers, the people were led to expect a more intense shock, and many stayed out of doors all day. One did not come that day. It is safe to predict that an earthquake will probably reaffect an area once affected, but it is folly in the present state of seismological knowledge to predict just when and where an earthquake will occur.

The predicted return came all too soon, unexpectedly, on November 10 (see Nature, November 16, p. 647). It was heralded by minor tremors in various parts of the Balkan States on the night of November 9, but the terrific shock came on November 10 in the early morning. For what appeared to be an age, but actually for perceptibly five minutes, Bucharest and most of Rumania and the surrounding area shook more than they had done since 1802. The people of Bucharest knew it when, with a terrific crash, their new eleven-story Carlton flats crumpled into rubble. Nor was this all. The new building of the Foreign Ministry cracked from top to bottom. The Royal Palace and the headquarters of the Rumanian Army were severely damaged. The great pillars of the Post Office fell, and one crushed a motor-car and its occupants in the street. The gallery of the National Theatre crashed into the pit, and among other buildings two hundred were destroyed and four hundred damaged. Heavy rain fell while medical men, chemists, engineers, architects and private citizens called by the radio, assisted by firemen, the Iron Guard and the German troops, searched the wreckage for those trapped. Fires broke out and basements became flooded. More than a hundred and fifty are known to have been killed in Bucharest alone, and it is feared that thirty or more people are trapped beyond hope of rescue in the Carlton flats. More than a thousand badly damaged houses have had to be evacuated in Bucharest, and there is scarcely a house not affected in some way. The British Legation building had some of its inner walls cracked but was otherwise only slightly damaged.

Other areas in Rumania, including the oilfield towns and the port of Galati, were no less affected. At Ploëşti, after a vivid flash of lightning which put the telephones out of action, the earthquake severely damaged the town hall, a hotel, and the Standard Oil Company's offices. The refineries of the Standard Oil Company also have been compelled to close for ten days while repairs are done chiefly to the pipe lines. In this town also the prefecture, the chamber of commerce, and a number of private houses were destroyed, and sulphur fumes escaped from ground fissures. The Astra Romana Oil Company plant was damaged and fires broke out. At Focsani, an oil town, 70 per cent of the houses in the centre of the town are said to be razed and hundreds of people rendered homeless. At Giurgiv, an oil port on the Danube, 65 per cent of the houses are reported destroyed. At Buzeu, about sixty miles north-east of Bucharest, hundreds of buildings have been destroyed and many people killed. Damage has been done at Ramnicue and Sarat and half the villages in the Prohava oilfields have been razed. Pangui is said to have been completely destroyed and there are twenty-three dead and seventy-one seriously injured. At Jassy, four were killed and six gravely injured. In the whole district tens of thousands of peasants are homeless and the casualties are only small because of the flimsy nature of the peasant buildings.

Damage to the oil wells themselves is uncertain at present. The only fire was quickly extinguished and the pipe lines and steel casements are being examined. The prison for political prisoners at Dostrana near Campina collapsed and about a hundred people were killed. Galati, the grain and oil port, suffered severely. The cathedral and St. Helen's church were destroyed, scores of houses severely damaged, and the casualties were reported as thirty-six killed and a hundred and thirty injured. At Rutschuk, just on the Bulgarian side of the frontier, ten houses were damaged and fifteen persons injured. At present it is difficult to assess the total damage in the whole area. Telephone communications are still interrupted, and some railways have not yet resumed operation pending the examination of tracks, lines, and bridges. A conservative estimate puts the total damage at two and a half million pounds and the casualties throughout the country as four hundred killed and eight hundred severely injured.

Outside Rumania, the shock was felt in Sofia and many parts of Bulgaria though no damage is reported except at Rutschuk. It was also felt at Istanbul in Turkey, and in Moscow an earthquake at 4.40 a.m. local time stopped some clocks and moved some furniture. In Russian-occupied Poland, buildings are said to have been destroyed at Kishinov and Lwow, while at Brazov in the Carpathians terror was caused.

From all this information it is possible to construct provisional isoseismal lines. The Modified Mercalli Intensity Scale of 1931 as used by the United States Coast and Geodetic Survey has been used, which ranges from 1 to 12. A few outstanding intensities might be mentioned:

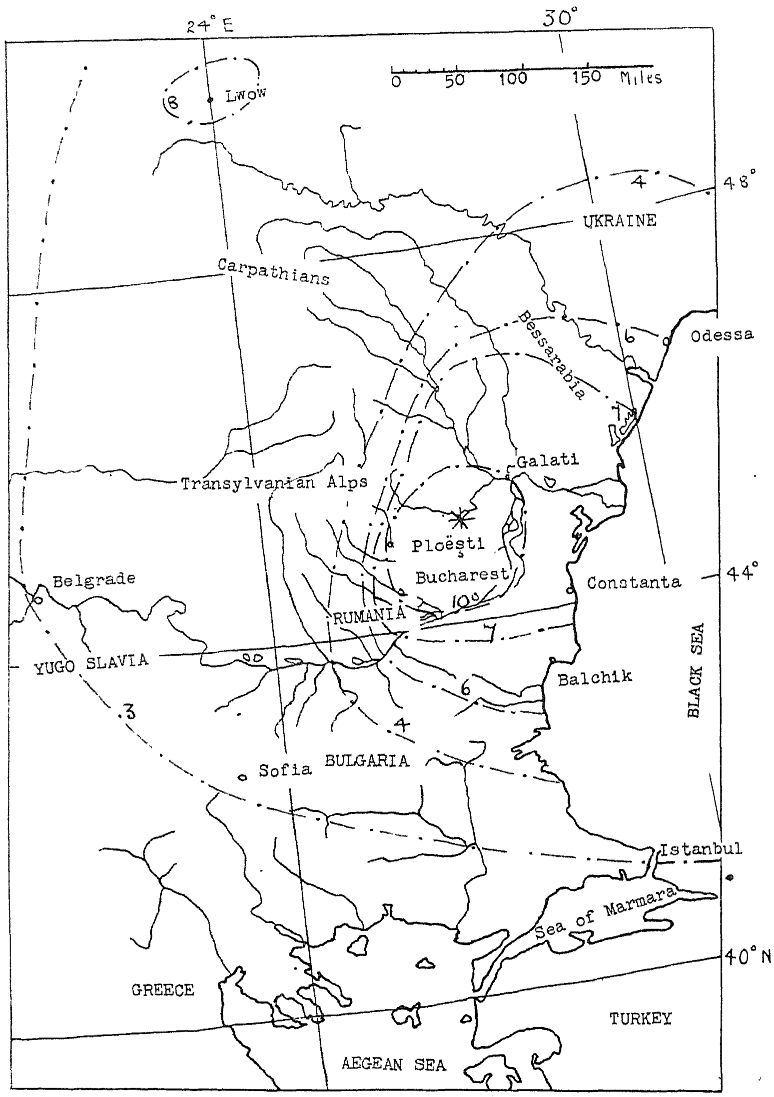
1, not felt except by a very few in especially favourable circumstances;

5, felt by nearly everyone; plaster cracked; unstable objects overturned;

10, most masonry and frame structures destroyed with foundations; ground badly cracked; landslides from steep slopes;

12, damage total; waves seen on ground surfaces; objects thrown upward into the air.

It will be seen that the shock reached intensity 10 on this scale in the epicentral area but not 11 or 12, which are extremely rare. There are, however, some curious points. In the Carpathians at Brazov the shock had diminished to intensity 4; but if it was the same shock at Kishinov and Lwow in Poland, it had again increased in intensity to 8 at these places, and was even of intensity 5 in Moscow. At first sight it appears as though there may have been two shocks at very nearly the same time. A thorough examination of the seismograms from near stations would decide this point. Reports from Odessa, the grain port on the Black Sea, indicate that intensity 6 was attained there, while Belgrade, Sofia and Istanbul experienced the earthquake at intensity 3.



Sketch map of Rumania and the surrounding area showing isoseismal lines on the Modified Mercalli Scale

Isoseismal lines, — · — · — · 6 · —; *, epicentre.

Only isoseismal lines for which there is evidence have been drawn on the accompanying map, though it appears that, with the exception of the region near Lwow, the intensity of the shock decreased fairly regularly with increasing epicentral distance. Immediately towards the west of the epicentral area the isoseismals indicate a more rapid falling off at first than in other directions. This may be due to the geological structure. It is noticeable that the isoseismals cover a very wide area, which may point to a focus rather deeper than normal. The wide area covered by the isoseismal 10 and lack of further macroseismic

evidence makes it difficult on these grounds to pin-point the epicentre.

It was tentatively suggested by the Meteorological Office in Sofia that the epicentre was about 210 miles from Sofia, but the centre of the inner isoseismal is at a rather greater distance than this. At the moment it is more correct to speak of an epicentral area than of an epicentral point.

I am indebted to the Rev. J. P. Rowland, *S.J.*, for the Stonyhurst east–west Milne–Shaw seismogram of magnification 150. This has certain peculiarities which are well worth mentioning. Of the first waves to arrive, P were impulsive at 01h. 43m. 45s. G.M.T., the double amplitude being nearly 4 inches. These waves had nearly died down when a very strong impulsive S wave arrived at 01h. 47m. 17s. G.M.T. The maximum amplitude for the whole shock appeared to be an S wave coming immediately after the S onset. It exceeded the limits of registration (paper 9 in. wide) and the S waves included some oscillations too rapid to be recorded. Father Rowland estimates provisionally that the ground oscillation at Stonyhurst was at least one eighth of an inch. The surface waves (L) had a maximum double amplitude on the seismogram not exceeding 3 inches, and the waves from the shock had not quite died away after nearly 4 hours. PP, PPP, P_cP, SS, SSS and S_cS waves could be discerned but no PS, PPS or SSP waves. sP, sS and SR_1 pulses were identified but not pP. Three of these latter are characteristic of earthquakes with a deeper focus than normal, and from the Brunner Chart a depth of focus of 300 km. was estimated together with an epicentral distance of 2,330 km., or nearly 21°.

I am indebted to the Director for the readings of the Kew seismogram. iP (dilatation) occurred at 01h. 43m. 18s. with the epicentral distance estimated at 2,090 km. The onsets, maxima and periods of the various phases were very similar to those at Stonyhurst, and the waves could be traced for more than 4 hours. An average estimate of the initial time of the shock is November 10, 1940, 1h. 39·2m. G.M.T. and the epicentre near latitude 45° N., longitude 27° E.

There has been some discussion in Great Britain, South Africa and the United States (NATURE, January 6, 1940; March 16, 1940; and *Earthquake Notes*, September 1940) of the possibility of the waves from one large earthquake acting as a trigger action for an earthquake in another part of the world. The matter has not been decided; but in this connexion it might be mentioned that on the day of the great Rumanian earthquake, shocks were felt in Poland and Moscow, the latter said to have been the greatest in the history of the city, also shocks in Santa Barbara (California) and Santiago de Chile.

Aftershocks of the Rumanian earthquake have been violent and frequent. Five of these were at 8.30 a.m., 8.35 a.m. and 9.30 a.m. on November 11 and two shocks on the night of November 12. These were not registered at Kew.

Altogether, the shock constituted one of the great earthquakes of the world, but not one of the greatest. It was the greatest in Rumania since 1802, but was not so great as the Turkish earthquake of December 1939 (NATURE, January 6, 1940).

OBITUARIES

Sir Herbert Wright

THE death of Sir Herbert Wright, which took place recently at Chalfont St. Giles, removes yet another of the prominent figures of the earlier days of the plantation rubber industry. Born in 1874, he was educated at the Royal College of Science, London, and went to Ceylon as scientific assistant to the director of the Royal Botanic Garden, Peradeniya. He later became acting director, and from 1900 until 1906 was controller of the Agricultural Experiment Station in Ceylon.

During this period Wright was actively engaged in the many problems of the rapidly expanding Hevea rubber industry of Ceylon, and soon came to be regarded as one of the leading authorities on the subject. The results of his work and observations on rubber were published from time to time in the *Tropical Agriculturalist* of Ceylon, and in a book entitled "Hevea brasiliensis or Para Rubber, its Botany, Cultivation, Chemistry and Diseases", published in 1905; second and third editions of this work appeared in 1906 and 1908. Another book on rubber, "Rubber Cultivation in the British Empire", from his pen appeared in 1907.

Other tropical crops besides rubber occupied Wright's attention, notably cacao. He published a work on this crop ("Theobroma Cacao or Cocoa") in 1907, in which he presented the results of botanical and experimental work in other countries, and brought them into line with recent research in Ceylon. Citronella and lemon grass were other important Ceylon crops to engage his attention, and with the co-operation of planters he carried out a series of experiments on their growth, oil production, and general behaviour at different altitudes and in response to different soil conditions. He also made

contributions to the subject of foliar periodicity in the local flora, and made an intensive study of the genus Diospyros in Ceylon.

From 1907 until 1917 Wright was editor of the *India Rubber Journal*, London, and was associated with various public companies and trusts dealing with tropical agriculture. During 1931–38 he was chairman of the finance committee of the governing body and treasurer of the Imperial College of Science and Technology, South Kensington. He also held other offices in connexion with the Imperial College at different times. He was a fellow of the Linnean Society, and was knighted in 1930.

Mr. E. L. Rhead

By the death on October 19 of Mr. Ezra Lobb Rhead, one of the last remaining representatives of the older school of metallurgists passed away. For forty-five years he lectured on metallurgy and assaying in the Manchester College of Technology, being a representative of the University's Faculty of Technology from its inception in 1904.

He was a teacher with a special gift for, and love of, his profession, who inspired in his pupils a real affection. Of the thousands of students who passed through his department, many have risen to positions of eminence. From all parts of the world his old students corresponded with him, and this continued friendship was a source of great satisfaction to him, especially, perhaps, in the years after his resignation from his lectureship. His interest in the welfare of the teaching profession was particularly marked in his support of the Association of Teachers in Technical Institutions, of which he was the president in three successive years.

Mr. Rhead contributed papers on a wide variety of subjects to the metallurgical societies and institutions in which he was interested. He was the author of several text-books on metallurgy, foundry practice and assaying, and he enjoyed the confidence of manufacturers, to whom his scientific knowledge and practical experience were always available.

Perhaps the outstanding characteristic of Rhead was the affection which he inspired in all those who really knew him, and the great kindness of heart which he invariably showed to those who asked for his help and advice.

F. C. Thompson.

Mr. W. G. Spencer, O.B.E.

Mr. Walter George Spencer, the well-known surgeon and medical historian, died on October 31 after a short illness in Westminster Hospital at the age of eighty-three. He was educated at Weymouth College and St. Bartholomew's Hospital, and qualified in 1885. Throughout his career he was closely connected with Westminster Hospital, of which he was vice-president, as well as lecturer and successively assistant surgeon, surgeon, and consulting surgeon.

He was also a prominent figure at the Royal College of Surgeons, where he was a vice-president, a member of the Court of Examiners, and gave the Arris and Gale, Erasmus Wilson, Bradshaw and Vicary Lectures. During the War of 1914–18 he served as major in the R.A.M.C., and was attached to the Fourth London General Hospital. Besides his clinical activities he took a keen interest in experiments on animals, and contributed two important papers to the *Philosophical Transactions*, the first in 1891 in conjunction with Victor Horsley on "The Changes Produced in the Circulation and Respiration by Increase of the Intracranial Pressure or Tension", and the second in 1894 on "The Effect Produced upon Respiration by Faradic Excitation of the Cerebrum in the Monkey, Dog, Cat and Rabbit". He also delivered a Hunterian Lecture at the Royal College of Surgeons in 1920 on "Animal Experiments and Surgery".

Mr. Spencer did valuable service at the Royal Society of Medicine, where he was president of the Sections of Surgery in 1920–21 and the History of Medicine in 1926–28, as well as honorary librarian in 1916–28. He was also honorary librarian for many years at the British Medical Association, and a member of the Committee of the London Library, at which he was a frequent visitor until shortly before his death. His chief contributions to medical history were his "Westminster Hospital: An Outline of its History" (1924), his collaboration with Sir D'Arcy Power and Prof. G. E. Gask in the revision of Plarr's "Lives of the Fellows of the Royal College of Surgeons of England" (1930), and a translation of Celsus in the Loeb Classical Library (1935-38). He also took an active part in the organization of the second International Congress of the History of Medicine held in London in 1922, when he acted as honorary treasurer and co-editor with the present writer of its proceedings.

J. D. Rolleston.

We regret to announce the following deaths:

Mr. H. H. Baker, president of the New South Wales Branch of the British Astronomical Association, on August 13, aged seventy-two.

Dr. F. W. Edwards, F.R.S., deputy keeper of entomology in the British Museum (Natural History), on November 15, aged fifty-one.

Prof. E. W. MacBride, F.R.S., emeritus professor of zoology in the University of London, on November 17, aged seventy-three.

Dr. S. P. McCallum, University demonstrator in physics, Oxford, on November 16, aged forty-five.

M. Charles Nordman, director of the Paris Observatory since 1920, on November 15, aged fifty-nine.

Prof. Hans Rosenberg, an authority on astronomical photometry, formerly director of the Kiel Observatory and lately director of the Observatory at Istanbul, on July 26, aged sixty-one.

Prof. George Rutledge, professor of mathematics in the Massachusetts Institute of Technology, on September 21, aged fifty-eight years.

NEWS AND VIEWS

Royal Society Medallists

His Majesty the King has been graciously pleased to approve the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year to Prof. P. M. S. Blackett, F.R.S., for his studies of cosmic rays and the showers of particles which they produce, for his share in the discovery of the positive electron, for his work on mesons and many other experimental achievements, and to Dr. F. H. A. Marshall, F.R.S., for his contributions to the physiology of animal reproduction.

The following awards of medals have been made by the President and Council of the Royal Society: Copley Medal to Prof. P. Langevin, For.Mem.R.S., for his pioneer work in the electron theory of magnetism, his fundamental contributions to discharge of electricity in gases and his important work in many branches of theoretical physics; Rumford Medal to Prof. K. M. G. Siegbahn for his pioneer work in high precision X-ray spectroscopy and its applications; Davy Medal to Prof. H. C. Urey for his isolation of deuterium, the heavy hydrogen isotope, and for his work on the use of this and other isotopes in following the detailed course of chemical reactions; Darwin Medal to Prof. J. P. Hill, F.R.S., for his contributions to problems bearing on the inter-relationships of the main groups of the Mammalia and on the phylogenetic history of the Primates, a subject with which Charles Darwin himself was so much concerned; Sylvester Medal to Prof. G. H. Hardy, F.R.S., for his important contributions to many branches of pure mathematics; Hughes Medal to Prof. A. H. Compton for his discovery of the Compton effect, and for his work on cosmic rays.

The Dublin Institute for Advanced Studies

In Dublin, by an act of the Oireachtas, the Dublin Institute for Advanced Studies was founded in October. For the time being it consists of two constituent schools, the School of Celtic Studies and the School of Theoretical Physics. The general government of the Institute is entrusted to a Council, to which Rev. P. Browne (chairman), Dr. R. I. Best, Prof. D. A. Binchy, Prof. F. E. W. Hackett, Prof. E. Schrödinger were appointed by the President of Eire, whilst the President of University College, Dublin (Prof. A. W. Conway), the Provost of Trinity College, Dublin (Dr. W. E. Thrift) and the President of the Royal Irish Academy (Eoin MacNeill) are members *ex officio*.

The Institute will provide facilities for advanced studies and research in special branches of knowledge and for the publication of the results of such studies, irrespective of whether they have originated from the Institute or not. In particular, the scope of the School of Theoretical Physics is described as the investigation of the mathematical principles of natural philosophy and their application to the sciences in which they obtain. Both the training of advanced students in methods of original research and the provision of research facilities for professors and lecturers on leave of absence from their academic duties will be included. Seminars and lectures on topics which lie on the frontiers of knowledge are to be held. Financial aid for producing and publishing works within the scope of the School (but not necessarily originating from it) is envisaged. Admission to the Schools is granted by the Council of the Institute, to which applications, or inquiries of any kind, should be directed (64–65, Merrion Square, Dublin). Moderate fees will be charged, but a limited number of scholarships, including a substantial contribution to maintenance, are available. The first senior professor appointed to the School of Theoretical Physics is Prof. E. Schrödinger, formerly of the University of Graz. Apart from the Council of the Institute mentioned above, each School has a Governing Board. This Board, for the School of Theoretical Physics, includes: Prof. A. W. Conway (chairman), Prof. F. E. W. Hackett, Prof. A. J. M'Connell, Prof. W. H. McCrea (Belfast), Prof. A. O'Rahilly (Cork), Prof. E. T. Whittaker (Edinburgh).

Mr. Roosevelt and the "New Order"

With remarkable propriety, the occasion for Mr. Roosevelt's first public address after the presidential election was Armistice Day, November 11, when he spoke at the tomb of the Unknown Warrior at Arlington Cemetery. Equally appropriate was his choice of a theme—a review of the progress of democracy since the Declaration of Independence, when, as he said, a New Order came into being. In showing how the gospel of democracy has been carried among peoples, great and small, by the Americas, "all of the Americas" and the British Isles with them, the President brought the War of 1914–18 into a truer perspective, not as a useless sacrifice, but as a phase in the resistance to the doctrine that might is right which then made a definite effort to destroy this New Order after its relatively short trial. The struggle of 1914–18, Mr. Roosevelt continued, preserved the New Order of the ages for at least a generation; and had the Axis of 1918 been successful over the associated nations, resistance on behalf of democracy in 1940 would have been impossible. At the same time, he recognized and impressed upon his hearers the need for great flexibility in the methods of democracy. Certain facts of 1940 did not exist in 1918. There is need for the elimination of aggressive armaments, the breaking down of barriers in a more closely knitted world and a need for restoring honour

in the written and spoken word. To attain these purposes the processes of democracy must be much improved.

In thus foreshadowing in general terms the process of future growth in the democratic idea, Mr. Roosevelt was contemplating democracy as of the spirit, as a way of life and not merely as a political system, contrasting it with another 'New Order' of which much has been heard recently. Of the methods of this latter no graver indictment could be set forth than in the preamble to the proposed post-War agreement of co-operation between Poland and Czechoslovakia, in which it is shown that among its other crimes the Nazi regime is exterminating the intellectual class and all manifestations of cultural life, while despoiling these countries of their treasures of art and science and persecuting all religious beliefs. Against the spirit of these and other Nazi crimes "unparalleled in all human history", the agreement between Poland and Czechoslovakia aims at setting up an association "which would become a new order in Central Europe and a guarantee of its stability", no less than the 'New Order' of the President of the United States, based upon "respect for the freedom of nations, the principles of democracy and the dignity of man".

Photographic Exhibitions of Indian Art and Religion

THE exhibition of photographs illustrating Indian art and religion at the Imperial Institute, South Kensington, London, which was opened by Mr. L. S. Amery, H.M. Secretary of State for India, on November 13, will repay careful study. It does, in fact, convey a clearer view of Indian genius and mentality than many collections of a more spectacular and imposing character. As Mr. Amery pointed out in declaring the exhibition open, just as Europe in the Middle Ages had embodied its ideas and ideals in the cathedral, so in India Hinduism had attained the highest artistic expression of its religious conceptions in the temple; and ornamentation and decoration were the natural media in which both the artistic and the mental perceptions of India were illustrated. In order to understand India, Mr. Amery went on to say, it is necessary to have a perception of her architecture, her sculpture and her temple symbolism. The selection and grouping of the photographs in this exhibition, as well as the carefully prepared captions, are such as to give the visitor who examines them with attention, even if his previous knowledge of Indian art be slight, something more than a superficial view of the three aspects of Indian culture to which Mr. Amery referred; moreover, he will be impressed by the subtlety which pervades all Indian religious art, whether Hindu, Buddhist or Jain, and makes it in virtue of its all-pervading symbolism so remarkable a vehicle for conveying theological and philosophical concepts and ideas.

The arrangements for the exhibition have been made by the India Society and the Warburg Institute. The photographs, which attain a high standard of technical skill, are the work of Dr. Stella Kramritsch, lecturer on Indian art in the University of Calcutta. They illustrate developments in Hindu temple architecture and religious art, inclusive of such reform movements as Buddhism and Jainism from 200 B.C. to A.D. 1700. Broadly speaking, the arrangement is chronological; but since, as already indicated, interest centres upon religious concepts rather than æsthetic principles and achievement, though the latter are by no means passed over, examples are grouped and classified to illustrate these concepts. Naturally, in the early phases the Indianization of classical Greek art in Northern India figures prominently, while the group covering the setting of the temple demonstrates characteristic examples of the geographical environment as well as external form. Attention may be directed in particular, however, to the illustrations of the growth and meaning of symbolism, as well as of the worship of the symbol, and its plan in Indian religion and philosophy, the most striking example of this to the Western mode of thought being the manner in which the rhythms of the body as in dancing, or its functions as in sexual relations, are made to express a state of mind on a cosmic principle.

Antiseptics in War-Time Surgery

THE winter session of the Pharmaceutical Society's evening meetings was inaugurated on November 14 by Prof. A. Fleming, professor of bacteriology in the University of London, who delivered a lecture on "Antiseptics in War-Time Surgery". He said that in the present War surgeons should be able to undertake their work more efficiently than they were in 1914 in view of the chemical antiseptics which are now available but were then lacking. Thus the present situation in respect of the treatment of war wounds is infinitely more satisfactory than it was in the War of 1914–18. The antiseptics in use in 1914 have since been shown to be of little value for use in war-time surgery. Carbolic acid, for example, is effective when used otherwise than in connexion with the human body, but inside the body its lack of value is shown by the diminution of its efficiency with increasing concentrations, this being due to its action in destroying the leucocytes. Consequently carbolic acid is not of any great use as an antiseptic in the treatment of wounds.

Prof. Fleming also pointed out that the dyes are of little value as they are absorbed by the cotton wool used in dressing the wounds. Regarding antiseptics belonging to the sulphonamide group, he gave a warning against placing too much faith in them. They are not, he said, general antiseptics but are specific to certain bacteria; further, the action of these antiseptics is neutralized by chemicals, pus and dead bacteria and they are therefore of little value in the treatment of seriously septic wounds, in which pus and bacteria were inevitably present. The virtue of this new group of antiseptics is in their high solubility; they dissolve to form high concentrations in the wound. The sulphonamides are of great value in the treatment of fresh wounds where pus and bacteria are absent, since they inhibit the growth of certain important bacteria, and there is nothing in the fresh wound to inhibit the action of the sulphonamide.

The Albanian Fauna

The extensive fighting in Albania is in a region rich in natural history interest, particularly ornithology, where Hugh Whistler, Dr. Ticehurst, Prof. P. A. Buxton, W. E. Clyde Todd and Ludwig von Fuehrer have made collections in recent years (*Ibis*, 1929, 1932, 1936) and 272 bird forms have been listed. Nesting chaffinches examined from Albania have been found to be *Fringilla cœlebs balearica* and not the typical form, but there is much of British interest in the bird life. Jays are fairly common in the valleys, up to 1,200 ft., and they have been seen at 1,500 ft. in the Logra Forest on the Acroceraunian Mountains. Magpies (*Corvus cernix sardonius* and *Corvus monedula soemmerungii*) are not so common as formerly reported, and not usually above 2,500 ft. Orioles are common. In his expeditions from Valona to the Acroceraunian Range in 1935, Whistler for the first time verified the great black woodpecker occurring in the country (*Ibis*, April 1936), while birds collected by Ludwig von Fuehrer in 1932 are now in the Carnegie Museum at Pittsburgh. The Spanish sparrow and blackbird are widespread, though local, and there are tree-creepers, marsh-tits, rock-nuthatches, numerous Spanish wheatears, and the robin nesting at 2,500 ft. in the Logra Forests. The imperial eagle nests in open country, the goshawk in the Jinokastro valley, and there are hobbies, peregrines, sea-eagles and harriers; white storks inhabit the ruined towers in summer and a colony of pygmy cormorants nests in the middle of the Lake Terbuf. Colonies of egret nest on the marshes at Durazzo, Valona, etc., along with garganey, pintail, bitterns, purple herons, Kentish plover, pelicans, and yellow-legged herring-gulls, and the adjoining woods have six species of woodpecker, hazel grouse, capercailzie, Cetti's warbler and subalpine warblers. The alpine accentor and alpine chough inhabit the mountains, the thick-billed reed-bunting, bearded reedling and penduline tit the plains, the dipper is common at the mountain streams, the crested tit in the fir forests and the red-rumped swallow in many districts.

Leeds University Union's Loan

The University Union, comprising the whole body of students of the University of Leeds, has decided to lend to the Government free of interest the sum of £1,000. In consequence of the postponement of the construction of the proposed swimming bath and of the extension of the existing gymnasium, the Union found itself with a balance of money which had been set aside for use in connexion with those new developments. In these circumstances the Union Committee felt that this money might appropriately be placed in the hands of the Government until such time as it can be devoted to its original purpose, that is until building work again becomes possible after the War. The University authorities approved of the Committee's proposal and of its wish to forego interest on the loan. The Union has also invested the sum of £400 in Defence Bonds.

The New "Nomenclator Zoologicus"

It is satisfactory to be able to report that the publication of the "Nomenclator Zoologicus", an announcement respecting which was made in Nature of February 25, 1939, p. 326, has now been completed. Moreover, in spite of the inevitable difficulties that have arisen out of the conditions under which the later volumes have been produced, the final one has appeared nearly two months in advance of schedule. The work, which covers the literature from 1758 to the end of 1935, is contained in four volumes, the last of which includes a supplementary list of addenda and corrigenda. It contains in all about 227,000 entries, including cross-references, though it is probable that these do not represent more than about 190,000 genera or subgenera treated as distinct by present-day systematists. Of these, the Arthropoda represent more than 70 per cent of the whole, the Insecta alone representing 50 per cent.

In the preparation of the work, the editor, Dr. S. A. Neave, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7, has had the ungrudging assistance, not only of most of the staff of the British Museum (Natural History), but also of numerous other zoologists both in Great Britain and abroad. The work is published for the proprietors by the Zoological Society of London, which has borne the main cost of compilation. Thanks to grants from outside sources, including the Carnegie Corporation of New York, it was found possible to issue the complete work of more than 3,800 pages to original subscribers at the low price of six guineas; but it has now been found necessary to raise this to ten guineas.

Luigi Luciani

Prof. Luigi Luciani, the celebrated Italian physiologist, was born at Ascoli Piceno on November 23, 1840. He received his medical education at Bologna and Naples, and qualified at Bologna in 1868. After acting as assistant to Vella in the Institute of Physiology at Bologna he spent nearly two years in the corresponding institute at Leipzig under Ludwig. On his return to Bologna he became lecturer in experimental pathology and also devoted himself to the study of the physiology of respiration. In 1875 he was appointed professor of physiology at Parma, where he remained for five years. In 1880 he succeeded Giannozzi in the corresponding chair at Sienna, and shortly afterwards became professor of comparative physiology at Florence, where he remained from 1880 until 1892. During this period his most important work, namely, that on the cerebellum and fasting, was carried out. Finally, he occupied the chair of physiology at Rome, which he held until his retirement in 1917. His original work consisted mainly of his studies on the physiology of the cardiovascular system, the cerebral cortex and cerebellum muscular movements and fasting, the last being carried out on Succi, the professional fasting man. He was also interested in phonetics, psychology, and the history of medicine. His most important publications were those on the functional

localization of the cerebellum (1885), the physiology of fasting (1889), and human physiology (1898–1903), the latter having been translated into English, German and Spanish. He died on June 23, 1919.

Louis Stromeyer Little

Mr. Louis Stromeyer Little, an eminent surgeon and astronomer, was born in London on November 23, 1840, the third son of Dr. William Little, the orthopædist who gave his name to cerebral diplegia. He was educated at St. Paul's School and at Kiel and Hanover. He qualified M.R.C.S. in 1862 and the same year became assistant surgeon at the London Hospital, and later was appointed to the National Orthopædic Hospital and St. Mary's Hospital for Women and Children. In 1866, when an epidemic of Asiatic cholera occurred in the East End of London and application was made to the London Hospital for assistance, he took an active and successful part in its treatment by intravenous injection of saline solutions. On the outbreak of the Schleswig-Holstein War in 1864, Little first joined the Prussians, but afterwards joined the Danish forces. In 1869 he went to Shanghai where he soon acquired the best medical practice in the Far East. He also developed the knowledge of astronomy which he had acquired in London to a remarkable extent, and not only built an observatory at Shanghai, but also established the first telegraphic longitude observed in China by means of telegraphic signals with Nagasaki, 600 miles away on the opposite shore of the Yellow Sea. This achievement gained him the fellowship of the Royal Astronomical Society in 1877. After residence in China for nearly thirty years he returned to England via South Africa, where he was awarded the South African Medal for his services in the Boer War. He died on October 4, 1911.

Prof. Carlo Giacomini

Prof. Carlo Giacomini, an eminent Italian anatomist and anthropologist, was born at Sale near Alessandria on November 25, 1840. He obtained his medical qualification in 1864 at Turin, where he divided his time between anatomy and clinical medicine until 1880, when he was appointed professor of anatomy and gained a high reputation as a teacher. The classical researches with which he is connected are those on the anatomy and teratology of the brain, his method of preservation of the cerebral convolutions, the anatomy of the negro, and investigations on anomalies of development of the human embryo. He was also co-editor of *L'Osservatore*. The Museum of Anatomy at Turin owes much to him for its collections. He died at Turin on July 25, 1892.

The Newcomen Society

On November 13, at the Iron and Steel Institute, the Newcomen Society held its annual general meeting, and then listened to the reading of two papers. In the report of the Council for the year 1939–40, it was stated that 322 new members have been elected and the membership now stands at 1,512. The majority of the new members are citizens of the United States. Though owing to the stress of war two London meetings were cancelled, a good series of papers were read and many other activities were carried on. The Council sent a chaplet to Handsworth Church on November 15, 1939, to mark the centenary of the death of William Murdoch, and joint action was taken with the Smeatonian Society to place a tablet in the chambers in Gray's Inn occupied by Smeaton during 1783–1793; but the completion of this memorial has had to be deferred. Among the members whose death has been recorded during the year was Mr. L. F. Loree, who is regarded as the founder of the Society in the United States. After the report had been passed, the meeting re-elected Col. C. E. Davies, of New York, for a second year as president. The papers read were respectively by Mr. E. W. Hulme and Dr. H. W. Dickinson, the latter dealing with the work of Henry Cort, the inventor of the puddling process for the manufacture of wrought iron, while Mr. Hulme's paper was entitled "Prehistoric and Primitive Iron Smelting: Part 2, The Crucible Processes of the East". It has been decided owing to the conditions prevailing that no meetings will be held in December and January, but if possible a resumption will be made in February.

Eradication of Bracken

Bracken has become an increasing menace in recent years, and vigorous efforts are being made to find cheap and efficient means for its eradication. Although systematic cutting or crushing can be entirely successful, the process is slow, about eight cuttings at the rate of two a year being required. A more rapid method of destruction is achieved by either broadcasting or spraying with sodium chlorate, but as 2 cwt. per acre is needed the cost (approximately £4 an acre) is prohibitive. Chlorate, however, is much more toxic when introduced directly into the plant, and Dr. G. H. Bates has devised a mechanical method whereby the chemical can be applied to the cut end of the bracken frond. The chlorate added in this way rapidly kills the aerial portion, and ultimately destroys the underground rhizomes of the plant; only 15–20 lb. of the chemical is required per acre.

The apparatus and method of use are described in Bulletin 14, Rubber and Agriculture Series, published by the British Rubber Publicity Association, 19 Fenchurch Street, London. Bracken crushers or cutting machines which break or bend the stem are not suited to this direct application technique, as unbroken continuity of the vessels is essential for proper penetration of the chlorate; but with hand scythes or machines with reciprocating knives it works well. A small attachment strapped to the worker's belt has been devised for use with a hand scythe. It does not weigh more than 10 lb. when filled with solution and needs only be replenished about four times daily. A rubber tube serves as a feed on to a sponge rubber pad, backed by a meta plate which is attached to the scythe blade. The rate of flow can be controlled. A somewhat similar device

which has proved very efficient has also been constructed for attachment to a motor-scythe, and no special skill is required in its use. Experimental work on the subject is being continued, and it seems possible that given good weather conditions, complete eradiction of bracken may ultimately be obtained after a single cut.

Rationing of Manufacturers' Supplies

It has recently been suggested to us that in placing orders for material or apparatus, an authority for the order should always be quoted in order to secure release of material. In an article on "The Manufacturers' Order Book" by "Sala" which appears in the *Electrical Review* of November 8, the whole problem raised by questions of priority is discussed. Almost every manufacturer of materials required in the war effort has to decide whether to refuse orders for the time being or to limit the acceptance of orders so as to bring them into line with his estimated output. The manufacturer can obtain but little guidance from his customers as to the urgency of their requirements, for each will rightly demand preference in view of the material being required for urgent Government work. It may also happen that material ordered through the usual trade channels is required for some vitally important part of the war effort and demands priority over orders received direct from Government departments. One way out of the difficulty is for the manufacturer to see that each customer will get a portion of his requirements. This rationing of supplies rarely solves the difficulties. The manufacturer realizes the inadvisability of refusing orders particularly as he generally has no means of authenticating their vital importance in comparison with the uncompleted priority orders still on his books. He feels that the responsibility of limiting or reducing the amounts specified in a consumer's order should not be left to the manufacturer.

Mosquito Control in Great Britain

The Ministry of Health has recently published a "Memorandum on Measures for the Control of Mosquito Nuisances in Great Britain" (No. 238, Medicine, 1940) by Lieut.-Col. J. A. Sinton and Mr. P. G. Shute. While mosquitoes may carry malaria in certain circumstances in Britain, as happened during and after the War of 1914–18, it is mainly because of the nuisance caused by the bites that anti-mosquito measures are undertaken in Great Britain. Of the 29 recorded species, eight are so rare or so seldom bite man that they may be considered unimportant from the public health point of view. *Anopheles maculipennis* is the potential carrier of malaria and during the past twenty-five years more than 500 cases of the disease have been proved to have been locally contracted in almost every instance through its agency. The habits, economy, and means of control of this and other British mosquitoes are dealt with in this memorandum. The information given is up to date and has obviously been carefully collated. If anti-mosquito measures are to be applied effectively and economically the species concerned must be identified and its habits taken into account. Specimens are identified free of charge at the Malaria Laboratory of the Ministry of Health or at the British Museum (Natural History). Once a given species is named the advice given for its control may be followed. The memorandum, it may be added, is to be obtained from H.M. Stationery Office or through any bookseller, price 6*d*. net.

A Parachute Fishing Net

Dr. J. F. G. Wheeler, director of the Biological Station at Bermuda, has succeeded in designing a workable net in the form of a parachute for catching small deep-sea planktonic organisms. The novel idea of a fishing net without a towing line is adapted from the method used by Prof. Maurice Ewing in his work on the sub-sedimentary rocks beneath the sea. The net fishes upside down. At the top is a fine mesh followed by a wider weave net; it then broadens out to a canvas-like material which has metal 'eyes' punctured into the bottom. From these 'eyes' are attached ropes or bridles. These come down in a V fashion to a small cord to which is attached a wire receptacle in which is placed a large lump of rock salt. Beneath this are suspended two weights. At the top of the net, and inside it, is a funnel-like pipe leading into a bucket. Affixed to the top of the bucket are a float (a can filled with petrol) and a flag.

The net is nine feet three inches across its mouth and nearly thirty feet long. The two concrete weights total 138 lb. The apparatus is easily thrown into the sea. On its downward journey the net swells out and opens in a parachute-like form, retaining its shape on its descent. It catches as it goes down the minute plankton which enters the mouth and passes into the bucket through the funnel. The net touches the bottom. The salt has by this time dissolved (the requisite amount having been roughly calculated) and the weights are released. The closed parachute is then brought to the surface by the float. The net was successfully used at a depth of more than 1,000 fathoms. Its advantages over a tow-net are that it can be handled easily by a small crew in calm weather, and can be left to itself while the boat is elsewhere. Also that the specimens are in better condition when brought to the surface.

The American Museum of Natural History

The Americas for the moment are fortunate in being so far removed from the theatre of war as to be able to continue scientific investigation in the field, even though it be only on a restricted scale. During the past summer, the American Museum of Natural History has sent expeditions for zoological and palæontological research to Alaska, Kansas, Texas and Dakota (*Science*, August 16, 1940). The expedition under Dr. Walter Grainger, curator of palæontology in the Museum, which is exploring the Big Badlands of South Dakota for fossils of the three-toed horse, the pygmy rhinoceros, and cats, especially the sabre-toothed tiger, is accompanied by

Junius Bird, assistant in the Museum's Department of Anthropology. Mr. Bird will conduct excavations in the recent deposits overlying the fossil beds, in which have been found evidence of early human occupation, such as chalcedony tools, including scrapers and knives, and sherds of a black pottery.

An expedition under Dr. Grace Ramsay Fisher, of the Department of Education of the Museum, has been engaged in recording the life and work of Indian artist craftsmen in Mexico, a field in which surviving primitive conditions still afford a profitable field of research and recordings. Collections will illustrate typical examples of representative native craftsmanship in weaving wool, cotton, and plant fibres, embroidery and beading, pottery, showing the regional designs, leather, metal and lacquer work, masks, musical instruments and toys. The areas covered were central, south-east and south-west Mexico, and coloured motion pictures illustrate the life of their villages. This material ultimately will be circulated by the Department of Education for use in schools and other educational institutions.

Leprosy in Brittany

In his inaugural thesis (*Thèse de Paris*, 1940, No. 229), Dr. Y. M. Marhic states that leprosy disappeared from Brittany at the end of the seventeenth century, and no further mention was made of its occurrence there until 1892, when Zambaco Pacha, during a visit to the province, rediscovered the disease. Since then it has been the custom to describe Brittany as a leper country like the Mediterranean coast. Zambaco Pacha, however, found only two cases of leprosy in Brittany which were not indigenous, and since then only five cases in all have been described in Brittany in the course of forty-seven years, namely, one by Jeanselme (probably indigenous), one by Loussot-Netter (indigenous), three by Gouin, two of which showed *B. lepræ*, and two doubtful cases by Laferre, which were probably examples of leprosy without bacilli. Marhic therefore comes to the conclusion that leprosy does not appear to be more frequent in Brittany than in the other French provinces.

Jute-Growing in the U.S.S.R.

The All-Union Institute of Plant Cultivation of the U.S.S.R. has for the past thirteen years been carrying on experiments in the cultivation of jute, and has proved that this important industrial crop can be grown successfully in the Soviet Union. From among 150 varieties imported from India and various other tropical and sub-tropical countries and planted by the Institute in certain districts of Transcaucasia and Central Asia, the species *Corchorus capsularis* and *Corchorus olitorius* have been selected. These plants yield 13–25 per cent fibre, and produce a crop of seeds, which will make it possible to cultivate jute in the U.S.S.R. on an industrial scale. At present the Institute is endeavouring to acclimatize species and varieties with a greater yield.

Announcements

Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, has been awarded the George Robert White Medal of the Massachusetts Horticultural Society.

Sir Arthur MacNalty, chief medical officer of the Ministry of Health and of the Board of Education, is retiring on reaching the age limit. The Minister of Health and the President of the Board of Education have respectively appointed Sir Wilson Jameson to be chief medical officer of the Ministry and the Board. Sir Wilson Jameson is relinquishing the post of medical adviser to the Secretary of State for the Colonies, from which in the circumstances the Secretary of State did not feel that he could refuse to release him. He is also relinquishing the post of dean of the London School of Hygiene and Tropical Medicine and professor of public health in the University of London.

The Ministry of Food announces that the Flour (Vitaminization) Advisory Committee, which has recently been appointed, will have the assistance in its official capacities of Prof. D. M. S. Watson, F.R.S., of the Scientific Sub-Committee of the Food Policy Committee of the Cabinet, of Mr. P. N. R. Butcher, of the Ministry of Health, and of the following officers of the Ministry of Food: Sir Norman Vernon (director of flour milling), Prof. J. C. Drummond (scientific adviser), Dr. T. Moran (deputy scientific adviser), and Mr. J. H. Pillman (manager for imported flour).

The following appointments have recently been made in the Colonial Service: P. R. Akehurst, agricultural officer, Nyasaland; L. H. Browne, agricultural officer, Nigeria; J. W. D. Goodban, agricultural officer, Nigeria; A. P. MacWilliam, agricultural officer, Trinidad; D. B. Murray, agricultural officer, Nigeria; P. Paino, agricultural officer, Nigeria; M. F. H. Selby, botanist, Nigeria; N. Harris, geologist, Uganda.

Dr. R. Lessing, of 50 Queen Anne's Gate, London, S.W.1, has a complete set of unbound copies of Nature dating from 1918 up to the current issue. He is prepared to present these to any person, school or institute. Application should be made to Dr. Lessing direct.

The Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered by Mr. H. J. E. Peake at 2.30 p.m. on November 26, at the rooms of the Institute, 21 Bedford Square, London, W.C.1. The subject of the lecture will be "The Study of Prehistoric Times".

The second of the Cantor lectures of the Royal Society of Arts will be delivered by Prof. S. J. Davies at 1.45 p.m. on November 25, at the Society's rooms, John Adam Street, Adelphi, London, W.C.2. The subject of the lecture will be "Recent Developments in Internal Combustion Engines".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Energy of Aliphatic Carbon Links

THE information about the strength of carbon links, obtainable from thermo-chemical measurements on organic substances, is of an indirect nature. If R is an alkyl (or other) radical, we can, from the heats of formation of RH, RX (and XY, YH), derive the thermal effect Q of a substitution of the type

$$RH + XY = RX + YH + Q;$$

and for a series of different radicals R these heats vary as the substitution heats in the corresponding reactions of the type

$$RH + X = RX + H + Q'.$$

For the magnitudes of Q' listed below, the heats of the reactions $X + Y = XY$ and $H + Y = YH$ are required, and have been taken from the compilation of Bichowsky and Rossini[1], with the exception of $H + OH = H_2O$ taken as $+ 115$ Cal.; the differences in Q' between different radicals R are, however, independent of these further assumptions and depend only on differences in Q.

TABLE 1. SUBSTITUTION HEATS, Q'. (EXOTHERMIC HEATS TAKEN AS POSITIVE)

	$X = CH_3$	$X = Br$	$X = OH$	$X = \beta\cdot$
CH_3H	$-15{\cdot}4$	$(-33{\cdot}9)$	$-16{\cdot}0$	—
C_2H_5H	$-13{\cdot}0$	$-30{\cdot}5$	$-10{\cdot}2$	$-68{\cdot}0$
n-C_3H_7H	$-12{\cdot}7$	$-30{\cdot}1$	$-\ 8{\cdot}8$	$-67{\cdot}5$
sec-C_2H_7H	$-10{\cdot}8$	$-27{\cdot}9$	$-\ 4{\cdot}5$*	$-66{\cdot}0$
tert.-C_4H_9H	$-10{\cdot}0$	$-25{\cdot}9$	$-\ 0{\cdot}6$*	$-64{\cdot}6$

In Table 1 the data for $X = CH_3$ and OH come from the papers of Rossini[2]. $\beta\cdot$ signifies a free valence in the β position, released by the removal of an H-atom. "Substitution" by $\beta\cdot$, e.g. for $R\text{-}CH_2\text{-}CH_2\cdot$, would consist in $R\text{-}\overset{\alpha}{C}H_2\text{-}\overset{\beta}{C}H_2\cdot = R\text{-}CH = CH_2 + H$. Measurements by Kistiakowsky and his school[3] were used for the columns Br and $\beta\cdot$, following the assumption substantiated by them that heats of addition on two neighbouring carbon atoms are independent. The substitution heat of Br on CH_4 was obtained by extrapolating the four figures below it, relating their trend to that of the two neighbouring sequences. In the CH_3 column the C–H bond strength in CH_4, which comes in as an additive constant, is given the value 103·6 deduced later in this letter.

TABLE 2. BOND ENERGIES.

	C–I	C–I (smoothed)	C–Br	C–H	C–CH_3	C–OH	α–β
CH_3–	53–54	55·0	69·7	103·6	88·2	87·6	—
C_2H_5–	52·2	51·2	65·9	96·4	83·4	86·2	56·6
nC_3H_7–	50·0	50·7	65·5	95·5	82·8	86·7	—
sec. C_3H_7–	—	(48·4)	63·1	91·0	80·2	86·5*	53·0
tert. C_4H_9–	45·1	46·3	61·0	86·9	76·9	87·6*	51·4

Table 2 shows the results of a combination of these Q' values with measured bond energies of C–I[4]. The 'smoothed' column is obtained by plotting the measured values against the Q' for RBr; the *sec.*-propyl value being thus interpolated. (Plotting the measured values against the velocity constants of the gas reaction $Na + ClR$ also leads to 55·0 for the CH_3–I bond.) The difference between R-Br and R–I bond strengths was assumed independent of R; this view is supported by unpublished measurements of Dr. G. N. Burkhardt on the equilibria $RCl + I' \rightleftharpoons RI + Cl'$ for various alkyl radicals. This difference was evaluated as $14{\cdot}7\ (\pm 0{\cdot}6)$ from data quoted by Conn, Kistiakowsky and Smith[3] on the heats of addition of hydrogen bromide and iodide respectively to ethylene and isobutene, and from the heats of formation of methyl bromide and iodide, ethyl bromide and iodide, and methylene bromide and iodide given by Bichowsky and Rossini[1]. The last column, $\alpha - \beta$, signifies the energy of the second valence in a double bond linked to the α-carbon of radical R (from which a β-hydrogen has been removed).

The most interesting result of this scheme seems to be the uniform trend of all the bond strengths (C–OH being almost constant), while C–H shows the strongest variations. This was not formerly expected; perhaps because it involves changes in the C–H bond energy on a much greater scale than hitherto thought likely. We shall attempt, together with Prof. M. G. Evans, in a forthcoming publication, a theory of carbon bonds in which the uneven rate of variation in the vertical columns of Table 2 is related to differences in the size and steepness of gradation of the ionic terms of the bond energies in question, as indicated by the parallel trend of increasing dipole moments in the R-halogen bonds.

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* The first comes from the difference in heats of combustion of *n* and *iso*propyl alcohols given by Parks and Huffman ("Free Energies of Some Organic Compounds" New York, 1932), combined with the heat of formation of *n*-propyl alcohol from propane (Rossini); the second from the difference in the heats of combustion of normal and tertiary butyl alcohols (Parks and Huffman) combined with Knowlton and Rossini's results for the difference in the heat content of *n*-pentane and *iso*pentane. Corrections for evaporation heats are made according to H. C. Brown (*J. Chem. Soc.*, 990; 1903). These results are probably uncertain to $\pm$ 2 Cal.

Q' for CH_3 and OH refers to 25°C., the Br and $\beta\cdot$ data to 82°C., and the C–I bond-strengths were determined between 400° and 500°C.

[1] Bichowsky and Rossini, "Thermochemistry of Chemical Substances" (New York, 1936).

[2] Rossini, F. D., *Bull. Bur. Standards J. Research.*, **13**, 29, 189 (1934); Knowlton, J. W., and Rossini, F. D., *ibid.*, **22**, 115 (1939).

[3] *J. Amer. Chem. Soc.*, **60**, 2764 (1938) and earlier papers referred to there.

[4] Butler, E. T., and Polanyi, M., NATURE, **145**, 129 (1940). Some data are from unpublished material.

Complex Rotatory Dispersion of Optically Active Tetrahydrofuryl-2-carbinol

The dextro- and the lævo-rotatory forms of tetrahydrofuryl-2-carbinol, obtained by crystallization of the brucine salt of its hydrogen phthalic ester, exhibit complex rotatory dispersion, the carbinol obtained from the (−) hydrogen phthalic ester having

$$\alpha^{20}_{6708} -2\cdot23°, \quad \alpha^{20}_{6438} -2\cdot36°, \quad \alpha^{20}_{4603} +0\cdot56°,$$

$$\alpha^{20}_{4032} +5\cdot69°, \ \alpha^{20}_{3392} +28\cdot4°, \ (l = 1).$$

Determinations of specific rotatory power of the carbinol at increasing dilutions in aqueous solution give a family of curves of which the inflexions, maxima and reversals of sign are displaced towards the ultra-violet as the dilution increases. (This effect has been observed with tartaric acid by Lowry and Austin[1].)

A similar family of curves is given by the specific rotatory powers of the carbinol dissolved in the simple aliphatic alcohols (5 per cent solution), the characteristic features of the curves being moved towards the longer wave-lengths as the molecular weight of the solvent alcohol is increased.

In dioxan solution the specific rotatory power in the visible spectrum is practically independent of concentration. The rotatory power of the carbinol is not peculiarly sensitive to temperature changes and the rotatory dispersion of its esters is simple.

A more detailed description will be published elsewhere when circumstances permit. We have to thank Dr. C. B. Allsopp, of Cambridge, for determinations of rotatory power in the ultra-violet.

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[1] *Phil. Trans.*, A, **222**, 249 (1922).

Classical and Quantum Reflections of X-Rays in Crystals

It appears desirable that we reply, though very briefly, to the comments that have appeared in Nature[1,2] on our first note[3] on this subject and which were evidently written before our second and supplementary note[4] had been published. Our purpose in these communications was very definite, namely, to indicate it as a necessary consequence of classical optics and of quantum mechanics that there should be two types of X-ray reflection in crystals, due respectively to static and to dynamic stratifications of electron density; in the language of quantum mechanics, these correspond respectively to an elastic collision of the photon with the crystal lattice and to an inelastic one in which part of the energy of the photon is transferred to the crystal as an optical vibration of its lattice structure.

From the optical point of view, the two types of reflections are on a very similar footing; we have respectively $2\,d \sin\theta = n\lambda$ and $2\,d^* \sin\psi = n\lambda$. Here $\psi = \frac{1}{2}(\theta + \varphi)$, where θ and φ are the glancing angles of incidence and quantum reflection measured with reference to the crystal planes under consideration. The dynamic spacing d^* and the corresponding static spacing d are connected by the vector relation $\overrightarrow{1/d^*} = \overrightarrow{1/d} + \overrightarrow{1/\triangle}$, where $\triangle$ is the phase-wave-length of the lattice vibration. The scalar magnitudes of d and d^* become indistinguishable when $\triangle$ is infinite or when, though finite, it is transverse to d. The law of quantum reflection then assumes the very simple symmetric form $2\,d \sin \frac{1}{2}(\theta + \varphi) = n\lambda$. More generally, $d^* = d$ when $\theta = \varphi$, but deviates in one direction or the other from it according as θ is greater than or less than φ.

For the experimental proof of our thesis, it is necessary that new reflections should be observed which are not greatly inferior in definition to the usual Laue spots, and in which reflections corresponding to different wave-lengths appear clearly resolved from each other as demanded by the Bragg formula. These features are precisely those which were observed and reported upon by us. The streaks and diffuse spots in Laue patterns noticed by earlier workers were not particularly relevant to our thesis, especially in view of the very varied and entirely different but apparently quite plausible explanations of them which had been put forward in the literature. It can, we believe, scarcely be contended that these earlier observations are, in any real sense, an anticipation of our fundamental observations and conclusions.

We have observed that the quantum reflections given by diamond are sharply defined over a wide range of incidences and continue to be visible even when the crystal is cooled down to liquid air temperatures. These facts wholly exclude any explanation of these reflections in the terms of the diffuse thermal scattering of X-rays (Faxen[5], Zachariasen[6]). Measurements made by us over a wide range of incidences also show that neither in the case of ionic crystals nor in the case of diamond are the observed positions of the reflections in agreement with a formula of the Faxen-Zachariasen type.

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Sept. 20.

[1] Knaggs, Lonsdale, Müller and Ubbelohde, Nature, **145**, 821 (1940).
[2] Zachariasen, Nature, **145**, 1019 (1940).
[3] Raman and Nilakantan, Nature, **145**, 667 (1940).
[4] Raman and Nilakantan, Nature, **145**, 860 (1940).
[5] Faxen, *Z. Phys.*, **17**, 266 (1923).
[6] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).

Isolation of Acetylsulphathiazole from Human and Rabbit Urines following Administration of *M.* and *B.* 760

Several reports have been made in the American clinical literature during the early part of this year of concretions in the urinary system and of crystals in the urine of humans treated with sulphathiazole (*M.* and *B.* 760). In some instances[1,2] these concretions and crystals are merely referred to as a derivative or a conjugated form of sulphathiazole; in other instances[3,4], however, the statement is made that the crystals are acetylsulphathiazole, although no chemical evidence for their identity is given.

During work in progress in this laboratory on the fate of sulphonamide drugs *in vivo*, we have had occasion to examine crystals from both human and rabbit

urines following administration of sulphathiazole. In each case, crystals were isolated, purified and compared with an authentic sample of synthetic acetylsulphathiazole (first described by Fosbinder and Walter[5]). The crystals of both human and rabbit origin were identical in all respects with the synthetic acetylsulphathiazole. Sulphathiazole urines were centrifuged and the deposit allowed to stand with dilute hydrochloric acid. The deposit was then collected and extracted with a large volume of boiling ethyl alcohol, from which acetylsulphathiazole separated on cooling. It was purified by recrystallization from 80 per cent aqueous methyl alcohol. It formed rhombic prisms which were very sparingly soluble or insoluble in most solvents tried. The purified acetylsulphathiazole from human urine had m.p. 257° C. and from rabbit urine, 258°; neither depressed the melting point of synthetic acetylsulphathiazole, m.p. 257° (Fosbinder and Walter[5] give m.p. 256°–257°).

In addition to this acetyl derivative, rabbit urine following administration of sulphathiazole contains appreciable amounts of a conjugated glucuronide, presumably a derivative of a hydroxysulphathiazole. We have isolated this conjugated compound as a barium salt and a study of its structure is now in progress. This compound would appear to be analogous with the glucuronide of hydroxysulphapyridine isolated by Scudi[6] from dog urine after administration of *M.* and *B.* 693, and with the glucuronide of a hydroxysulphanilamide which we[7] have isolated from the urine of rabbits treated with sulphanilamide.

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Oct. 17.

[1] Pepper and Horack, *Amer. J. Med. Sci.*, **199**, 674 (1940).
[2] Long, *J. Amer. Med. Assoc.*, **114**, 870 (1940).
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[4] Carey, *J. Amer. Med. Assoc.*, **115**, 929 (1940).
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[7] Thorpe and Williams (to be published).

Cryolite Films on Glass Surfaces

Many years ago Mr. Dennis Taylor patented the tarnishing of optical surfaces for the purpose of increasing the amount of light transmitted. To-day, cryolite treatment of surfaces has become a routine operation. The common explanation of the phenomenon is that: (1) equal portions of light are reflected back from the outer and inner surfaces of the film; (2) the phases of these portions are such that they interfere with and neutralize one another so far as visual reflection is concerned; (3) the cryolite film must have a definite thickness.

Such a theory might explain the reduced reflection on the basis of interference. It does not explain the increased transmission, the factor of real importance. In practice, so far as transmission is concerned, precise control of the thickness is not necessary. It is determined only by mechanical considerations. Is there any need to seek for an explanation other than the orthodox and well-tried surface transmission phenomenon?

From Young's formula, $\frac{(N-1)^2}{(N+1)^2}$, the proportion of light transmitted through an air – glass surface, whether entrance or exit, may be determined. In the case of an interface, the more general formula, $\frac{(N_1-N_2)^2}{(N_1+N_2)^2}$, may be used.

If 100 units of light fall upon a flint lens having a refractive index of 1·65, 94 units pass through the entrance air – flint surface and 88·4 pass through the exit surface, the total loss being 11·6 units.

If cryolite films having a refractive index of, say, 1·35 are formed on the flint glass surfaces, then 97·8 units will pass through the air – cryolite entrance surface, 96·82 will pass through the cryolite – flint interface, 95·85 will pass through the flint – cryolite interface and 93·75 through the exit cryolite – air surface, the overall loss being 6·25 units instead of 11·64. These figures agree with practical experience.

If the refractive index of the film were reduced to 1·285, the overall loss would be reduced to the minimum of 6·05. Any further reduction of the refractive index of the film would lead to an increase of the loss. If the refractive index of the film were reduced to unity, or if it were increased to 1·65, corresponding with the flint lens, the conditions in both cases would be those of an unprotected flint lens. As the best value for the film is the square root of the refractive index of the glass medium, it is obvious that the best results are obtainable the higher the refractive index of the glass, for the reason that it is difficult to obtain practicable films of much lower refractive index than that of cryolite.

So far as reflection is concerned, although the thickness within fairly wide limits does not appear to affect transmission, there is an apparent effect upon back reflection, a portion of which is variable in intensity as the result of interference.

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Oct. 29.

Hyperfine Structure in the Arc Spectrum of Bromine

In a recent publication[1] we showed that the deviation from the interval rule in the 5*s* $^4P_{5/2}$ term of the BrI spectrum fits quite well the quadratic interaction formula

$$E = a_0 + \tfrac{1}{2}aC + bC(C + 1),$$

which arises when the nucleus has an electrical quadrupole moment. We have detected an arithmetical error in our calculations, and when the correction is made, the fit is even better than that previously reported. Thus the two *independent* check values for the constant b are now 0·175 and 0·170 (formerly 0·175 and 0·161), leading to two independent values for a which are 47·14 and 47·10 (units are cm.$^{-1}$ × 10^{-3}). The corrected interaction formula now becomes

$$E = 230{\cdot}1 + \tfrac{1}{2}\,47{\cdot}12C + 0{\cdot}172C(C + 1).$$

We wish to take this opportunity for correcting a few minor misprints in our published tables of structures (which contain some 200 components). These appeared only on printing and have no effect on the reported analysis. In λ 4513 read 180 for 150 ; in λ 4391 read $\widetilde{90}$ for $\widetilde{182}$; in λ 8334 (Fig. 3) read 163, 195 for 153, 185 (calc.), and 162, 195 for 152, 185 (obs.), in λ 4592 read $\widetilde{165}$ for $\widetilde{65}$.

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Oct. 28.

[1] Tolansky, S., and Trivedi, S. A., *Proc. Roy. Soc.*, A, **175**, 366 (1940).

Ability of Respiratory-Stimulating Factors to Overcome Toxic Action of Germicides on Moulds

It is well known that germicides depress the respiration of both the micro-organisms and the tissues with which they come in contact. It has been shown that the depressant actions of a germicide on the respiration of the micro-organism and of the host tissue are directly correlated with the toxicities of the germicide for the organism and the host, and a comparison of these respiratory effects by manometric methods has been proposed for the evaluation of germicides[1].

In our laboratories it has been found[2] that the depressant action of germicides on the respiration of tissues can be overcome *in vitro* by the addition of various fractions from yeast which have been found previously to increase the respiration of yeast and tissues[3]. It has also been found that for certain of these fractions the ability to stimulate the respiration of yeast parallels the ability to stimulate yeast proliferation[4], although this is not always the case. In view of these two lines of work it became of interest to determine the effects of germicides and of certain of these respiratory-stimulating fractions (*RSF*) on the growth of moulds.

In typical experiments 28 Petri dishes were prepared containing Czapek's medium with different concentrations of germicide. These dishes were divided into four sets of seven each. The dilutions of germicide in each set were 1 : 1000, 1 : 10,000, 1 : 20,000, 1 : 50,000, 1 : 100,000 and no germicide, two sets containing phenyl mercuric nitrate[5] and two containing *n*-butyl-parahydroxybenzoate[6]. The medium in one set of each group contained one per cent of the *RSF*. Two sets were seeded with *Aspergillus niger* and two with *Penicillium glabrum* by placing one loopful of a sterile water suspension of the mould in the centre of the Petri dish. The fungi were grown at room temperature in the dark and were examined at intervals for a period of 14 days. Phenylmercuric nitrate alone was effective in inhibiting completely the growth of *A. niger* in a concentration of 1 : 100,000 and of *P. glabrum* at 1 : 20,000. Addition of one per cent of crude *RSF* (corresponding to Fraction *A*[3]) not only increased growth in the lower germicide concentrations where some growth took place normally, but caused growth equal to that of the control with the usually completely inhibitory germicide concentrations of 1 : 100,000 and 1 : 50,000 for *A. niger* and 1 : 20,000 for *P. glabrum*. Similar although quantitatively different results were obtained with Butaben. All experiments were repeated using Sabouraud's medium with similar results.

Experiments have further indicated that the crude yeast *RSF* also contains factors inhibitory to mould growth, that both the inhibitory and stimulatory factors are soluble in 85 per cent acetone, but that the inhibitory factor can apparently be removed by adsorption on charcoal. The acetone-soluble fraction is the most active of the fractions in increasing the respiration[3] and growth[4] of yeast and is inactive on the respiration of rat skin.[3] On the other hand, the acetone-insoluble fraction increases the respiration of skin but is not particularly active in stimulating growth and respiration of yeast or growth of moulds. It may thus be possible to use these active fractions in overcoming some of the toxic effects of germicides on the host without greatly impairing germicidal efficiency, and this possibility is being studied.

These facts are consistent with an interrelation between proliferation and respiration, although in many cases a more direct correlation has been found between glycolysis and growth[7]. This interrelationship is under investigation, as is the purification of the factors responsible for the observed effects.

Details of these experiments will be published later.

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Oct. 2.

[1] Bronfenbrenner, J., Hershey, A. D., and Doubly, J., *J. Bact.*, **37**, 583 (1939) ; Ely, J. O., *ibid.*, **38**, 391 (1939) ; cf. also Miller, B. F., and Baker, Z., *Science*, **91**, 624 (1940).

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[3] Cook, E. S., Kreke, C. W., and Nutini, L. G., *Studies Inst. Divi Thomæ*, **2**, 23 (1938).

[4] Cook, E. S., Hart, M. J., and Stimson, M. M., in publication.

[5] Weed, L. A., and Ecker, E. E., *J. Infect. Dis.*, **49**, 440 (1931) ; **52**, 354 (1933).

[6] Butaben, Merck. We wish to thank Dr. R. T. Major of Merck and Co., Inc., for a gift of this material.

[7] Trowell, O. A., and Willmer, E. N., *J. Exptl. Biol.*, **16**, 60 (1939) ; Pomerat, C. M., and Willmer, E. N., ibid., **16**, 232 (1939).

Siegesbeckia orientalis in Britain

It is interesting to note that almost simultaneously with the publication of the note in Nature of October 12 of the twelve-year establishment of a colony of the alien composite *Siegesbeckia orientalis* at Freshfield Station, Lancashire (botanical vice-county 59), I have been able to add to my herbarium a specimen from a new station at Rufford, twelve miles inland westwards, and it is of further interest that some of the flower-heads have six bracts. It appears that the Rufford colony has been growing for some years in a sandy wild garden but was only recently identified in our work on the local flora for the Rufford Village Museum exhibit. It was locally believed that the plants might have been introduced with poultry food for they flourish abundantly and spread rapidly, especially after a bonfire. There is, nevertheless, the possibility of birds or hares transporting seeds adhering to sticky bracts from the Freshfield site.

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Oct. 19.

RESEARCH ITEMS

Iron Age Cypriot Jugs

THREE jugs of Iron Age date from Cyprus have been figured and described by James A. Stewart (*Man*, October 1940). These jugs are now in the Biblical Museum, Melbourne. Their provenance is unknown; but it is believed that they are derived from one of the cemeteries between Avios Jakovos and Enkomi. The first has an ovoid body with ring base and strap handle, buff clay and surface slip painted in black with red filling, showing a bird flying to the right, with a lotus bud before it. Eyes consisting of concentric circles appear on either side of the spout. The second jug is of the same type with differences in size and form—yellowish-buff clay and surface slip painted wholly in black figuring a horned quadruped in profile to right, all four legs being hind legs with bird-like claws rather than hoofs. The head is fitted with concentric circles, the neck with basketry panels. The third jug is of similar type. The decoration on buff clay and slip is in black paint with red filling. On either side of a complex lotus design is a flying bird feeding from the lateral bloom. In the field above the bird's head is a swastika. The period is probably Cypro-Archaic I, eighth–seventh centuries B.C.

More Life-Histories of North American Birds

ARTHUR CLEVELAND BENT has added a thirteenth to the magnificent series of volumes describing the life-histories of North American birds, and in it he includes the parrots and parakeets, cuckoos, kingfishers, goatsuckers, swifts, and humming birds (*Bull. U.S. Nat. Mus.*, **176**, 506; 1940). The work is compiled with the usual thoroughness, as full a life-history as possible being given of the best-known subspecies of each species, with more restricted comments on any peculiarity shown by the remaining subspecies. Plumages are described in sufficient detail to enable the reader to trace the sequence of moults and plumages from hatching to maturity and to recognize the birds at any stage and at any season, and the range of each species and its forms is outlined. Many fine photographs of nests, nesting-sites, and young birds illustrate the monograph, which contains numerous statements of unusual interest. For example, in 1832 Wilson described the flocks of the Carolina parakeet, brilliant in its colourings of red, yellow, bright green, and soft blue, as being so large that "when they alighted on the ground, it appeared at a distance as if covered with a carpet of the richest green, orange and yellow", and the author traces the steps by which this, the only representative of the parrot family that bred within the United States, became exterminated by the direct intervention of man in the early years of the present century.

Mammals of Malaysia

THE scientific workers of the Raffles Museum at Singapore have added enormously to the knowledge of the fauna of their province, and now the present director, F. N. Chasen, has brought together his own and other observations upon mammals in a "Handlist of Malaysian Mammals" (*Bull. Raffles Mus.*, No. 15. pp. xx+209; 1940). The area dealt with is bounded in a general way by the 100-fathom shelf, and includes besides the Malay Peninsula, Sumatra, Borneo and Java, and the adjacent small islands. As a whole the mammalian fauna is evenly distributed throughout the area, pointing to land connexions in times geologically not remote, but there are indications of affinities with different mainland faunas. A large constituent, of Indo-Malayan origin, is widespread over the whole region, although in many cases it is absent from Java. Northern influences from Indo-China are apparent in western and eastern drifts, and an eastern drift entered by way of Borneo where many species stopped, while others went on to Java. Finally there is an element now confined to the area, predominantly inhabiting the mountains at an altitude of more than 3,000 ft., and best represented in Borneo, which is most favourably constituted for the retention of old and the production of new animal forms. In Malaysia the mammals have been much more plastic than the birds, and in some cases the species are so split up that a list of the subspecies is little more than a list of the islands upon which the species is represented. Descriptions of thirty-nine new forms appear in the Handlist.

Development of Wings in Drosophila

HIGHLY interesting facts are reported by C. H. Waddington (*J. Genetics*, **41**, 75–137; 1940) from his work on the genetic control of wing development in Drosophila. The place in development of the wing at which mutant genes first show their effect and in some cases the reasons for the appearance in the imago can be deciphered by studies in the ontogeny of the wing. Sixteen stages in the development of the wing are described in wild-type flies. The first observable effects of thirty-eight mutant genes are shown to influence the development at one or more of these stages.

Genetics of the Tails of Mice

SEVERAL genetic characters which affect the structure of the mouse's tail also affect other structures or processes of the body. One of these inherited characters, short tail—Danforth—is associated with spina bifida, suppression of kidneys and parts of the uro-genital system (L. C. Dunn, S. Gluechsohn-Schoenheimer and V. Bryson, *J. Hered.*, **31**, 343–348; 1940). The homozygotes *Sd Sd* die within twenty-four hours of birth, probably as a result of auto-intoxication through an aberrant urogenital system. On continual crossing of the heterozygotes with the inbred Bagg strain of mice through several generations, it was found that the tail became shorter. Another character, brachy short tail (*T*), when combined with the characters of the inbred strain, tends to increase of length. It is suggested that the difference is due to the different morphogenic channels of development on which *Sd* and *T* act. It is probable also that the viability of the heterozygous *Sd sd* form is decreased in association with the Bagg inbred strain. This has developed so far as to make *Sd* approach the state of a dominant lethal.

Biochemistry of Flower Pigments in Verbena

G. H. Beale, J. R. Price and R. Scott-Moncrieff (*J. Genetics*, 41, 65–74; 1940) show that the various pigments in the flower of Verbena are exceptional in their genetic behaviour. In Verbena, delphinidin derivatives may be either dominant or recessive to pelargonidin, while mixtures of derivatives of pelargonidin and delphinidin or of both with cyanidin are known. In addition, clear-cut segregation of different glycosidal types, of acylated and non-acylated anthocyanins and of qualitative differences in flavone occur in Verbena. These exceptional phenomena are considered to be the result of the interspecific origin of the garden Verbena.

A Lower Carboniferous Brachiopod

A DETAILED study of *Daviesiella llangollensis* (Davidson) and related forms, including morphology, biology and distribution, has been made by F. W. Cope (*J. Manchester Geol. Assoc.*, 199–231; 1940). It has been found that the extra pair of muscle impressions in the ventral valve of *D. llangollensis*, previously believed to be additional adductors, are in fact secondary divaricator impressions. In North Derbyshire *D. llangollensis* (s. lato) is present in beds of S_2 and basal D_1 age; and specimens from these beds are divisible into two related groups: a lower one, confined to S_2, containing specimens differing from the lectotype in the condition of the secondary divaricator impressions (*D. derbiensis* sp. nov.); and a higher one, from the S_2–D_1 beds, in which the specimens are identical in every respect with the lectotype of *D. llangollensis* (s. str.). In North Wales, including Anglesey, and Westmorland the stratigraphical position of each species is the same as in North Derbyshire. It is concluded that the members of the *llangollensis*-gens are very shallow-water forms. The distribution of *D. llangollensis* is indicated on a sketch map which shows that the brachiopod appears to be present only to the north of the old Carboniferous St. George's Land. There is so far no evidence that the brachiopod exists in the South-Western Province of the Avonian.

Inactivation of an Enzyme

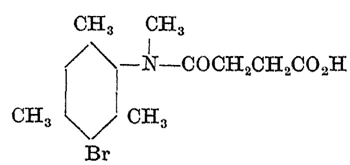
INFORMATION about the action of an enzyme might be obtained from the quantum yield on deactivation by light. If the specific activity is located in a definite part of the molecule a low quantum yield would be expected, whilst if the quantum yield is unity, inactivation may result from an alteration of almost any part of the large molecule. Urease has a high molecular weight of 483,000 and its light absorption must be distributed among several absorbing centres. E. W. Landen (*J. Amer. Chem. Soc.*, 62, 2465; 1940) has measured the absorption spectrum of urease in a pyrophosphate buffer solution at $pH = 5\cdot6$. A maximum molecular extinction coefficient occurs at about 2700 A. and a minimum about 2480 A. The quantum yield for inactivation is fairly constant over the region of wave-lengths 3103 A.–2537 A. and has the value 0·0008 molecule per quantum. It increases at shorter wave-lengths and reaches the value 0·00938 at 1860 A. The direct radiation from a low-pressure mercury discharge tube was more efficient in deactivating urease than monochromatic radiation of 2537 A., and this was shown to be due to radiation of wave-length shorter than 2350 A., probably the mercury line at 1849 A. The small quantum yield indicates that the enzyme activity resides in a unique region of the molecule. The divergence of the results from those of Kubowitz and Haas made in 1933, before the molecular weight of urease was known, are discussed and it is considered that the different experimental conditions are partly responsible.

Methylboric Acid

ALTHOUGH numerous monoaryl and alkyl boric acids have been prepared, the simplest compound of this class, methylboric acid $CH_3B(OH)_2$, has been missing. A. B. Burg (*J. Amer. Chem. Soc.*, 62, 2228; 1940) has now prepared this acid and its anhydride, which is trimeric $(CH_3BO)_3$, by an improvement of a method tried by Khotinsky and Melamed in 1909, namely, the action of methyl magnesium iodide on methyl borate. The crude product was dehydrated to methylboric anhydride by means of anhydrous calcium sulphate in a special apparatus. By treating the anhydride (m.pt. −38°, b.pt. 79°) with a deficiency of water and removing the excess of anhydride by distillation, methyl boric acid was obtained. This is volatile, but the vapour is extensively dissociated into anhydride and water, and its melting point is 95°–100° with decomposition. In contrast to the hydrolytic action of water, ammonia and trimethylamine form addition compounds with $(CH_3BO)_3$. By the action of boron fluoride a new compound, methylborondifluoride, is formed: $(CH_3BO)_3 + 2BF_3 = 3CH_3BF_2 + B_2O_3$. The compound $(CH_3)_2BF$, which was also not previously known, was prepared from dimethylboric anhydride (from phosphorus pentoxide and dimethylboric acid) by the reaction: $3(CH_3)_2BOB(CH_3)_2 + 2BF_3 = 6(CH_3)_2BF + B_2O_3$. Methylboric anhydride probably has a hexatomic ring structure with alternate boron and oxygen atoms in the ring, as is indicated by electron diffraction measurements.

Restricted Rotation in Arylamines

OPTICAL activity due to restricted rotation between a carbon of the ring and the nitrogen atom attached to it has been reported by Mills in the case of certain arylamines. R. Adams and L. J. Dankert (*J. Amer. Chem. Soc.*, 62, 2191; 1940) now report the resolution through its brucine salt of N-succinyl-N-methylbromomesidine, the formula of which shows that the molecule should exhibit a restricted rotation. The



compound was synthesized from mesitylene by way of nitromesitylene, mesidine, bromomesidine and N-methylbromomesidine, which was purified through the nitroso compound. The optically active forms were stable in boiling ethanol or aqueous sodium hydroxide, but gradually racemized in boiling *n*-butanol. The optical activity was shown to be due to restricted rotation between the carbon of the ring and the nitrogen atom and not to an asymmetric nitrogen atom, since the active forms were brominated to the inactive N-succinyl-N-methyldibromomesidine and were nitrated to the active N-succinyl-N-methylnitrobromomesidines.

AUTOMOBILE RESEARCH

ON the invitation of the Institution of Automobile Engineers, a representative of NATURE was privileged to inspect its new Research Laboratory at Brentford and to see a cross-section of the important work which is being done there under the superintendence of the director, Dr. E. Giffen, for the benefit of the automobile industry. The chairman of the Research Committee, Mr. W. A. Tookey, explained how its scope has been developed during the ten years since this co-operative work was taken over by the Institution and organized on a wide basis whereby it consists of representatives from the Institution, from affiliated members and from Government departments.

The work of the Committee is financed by grants from the Department of Scientific and Industrial Research and by contributions from the Society of Motor Manufacturers and Traders and from the affiliated members, who now number more than three hundred firms—including many who have their own research departments but at the same time find it an advantage to work in close co-operation with the Research Committee.

The new laboratory has been designed and built specially for the work being carried on there and provides excellent facilities for the many classes of investigations which arise in connexion with the engine, the transmission, the chassis and the operation of automobiles. Some of these give rise to questions of fundamental and general importance which at the same time involve problems of design and operation. A series of investigations illustrative of this range of interest is being developed at the present time which relate to the frothing or aeration of oil and to its harmful effects in service. In the chemical laboratory the fundamental causes which give rise to aeration of the lubricant are being investigated, and it may be anticipated that the results will yield information of wide application wherever frothing occurs either as an advantage or as a disadvantage in industry. Parallel investigations are being carried out in the chassis laboratory and in the engine laboratory to determine the effectiveness of de-aerating devices and to ascertain the influence of aerated oil on the behaviour and loading capacity of engine and other bearings.

Another investigation of a fundamental nature which is in course of development is intended to study systematically the factors which control the scuffing of piston rings, a phenomenon which can occur both under idling conditions and at high loads and temperatures. The work is being carried out on a single-cylinder, liquid-cooled unit coupled to a hydraulic dynamometer. The temperature of the jackets is closely controlled by the use of ethylene glycol in conjunction with a cooler, and the supply of lubricant to the cylinder walls is also under regulation. At the moment, the experimental work is directed towards the establishment of a satisfactory testing technique, and when this has been done it is proposed to examine the relative merits of various surface finishes and treatments for piston rings, and of different designs of rings.

The equipment of the cold room which forms a notable feature of the general laboratory has been designed to enable a detailed study to be made of the starting performance of engines at low temperatures. It can be operated at thermostatically controlled temperatures down to $-25°$ C. and is large enough to accommodate two full-size engines, mounted on test-beds run into the cold room on a movable ramp. A large capacity tank containing a low freezing point coolant is placed above the engines and by means of an electrically driven impeller and a system of three-way cocks the coolant can be circulated through either engine. The advantage of this arrangement is that it allows prolonged motoring test runs to be made without excessive temperature rise due to engine friction. The engines can also be driven through a swinging field dynamometer and a 10 : 1 reduction gear outside the cold room which enables a range of speed from 10 to 200 r.p.m. to be employed, while the incorporation of a free wheel in this gear permits the engine to accelerate when starting.

A line of research of very timely importance is one which is being arranged in order to study systematically the power loss resulting from the use of producer gas in a converted petrol engine. The gas used is produced from anthracite in an "Emergency" dry type producer which, in order to simulate road conditions, is mounted on a bumping rig and is subjected to a cooling air blast, in addition to the circulation of water through the jacket. The engine is a six-cylinder, side valve unit of 3·5 litres of a type commonly used in trucks up to three tons capacity. Immediately beyond the throttles, the gas and air are fed into a common pipe which acts as a mixing chamber. This pipe is connected to one branch of a tee-piece mounted on the engine intake manifold, the other branch being arranged to carry the normal petrol carburettor, which is enclosed in an airtight box. The arrangement of the controls in conjunction with this system of connexions permits the engine to be run either exclusively on producer gas or on producer gas combined with varying degrees of petrol enrichment. Provision has been made for manual adjustment of ignition timing, and in addition to studying the performance of the standard engine on producer gas, possible means of making good the power loss by raising the compression ratio, by increasing the calorific value of the fuel and by the injection of steam in the producer have been under investigation.

These by no means exhaust the tale of the activities of the station for many investigations of a routine nature are being pursued, such as gear testing, crankshaft fatigue testing, and measurements of the durability of bearings and bearing materials under different conditions. These are all yielding information of the utmost value to the industry and providing an accumulated fund of knowledge which will lead to improvements in design and higher efficiency in operation. This is well illustrated by a test which was seen in operation in the general laboratory and which had been arranged to obtain data as to the transmission of heat from a brake drum to a wheel rim and tyre. On buses operated under severe city service conditions, particularly in hilly districts, trouble arises in consequence of the excessive temperatures which reach the tyres and inner tubes, by

transmission of heat from the brake drums. At one end of the axle in the apparatus used for the test the wheels rotate against a continuous braking force applied through the normal brake rods, the braking load being shown on a spring balance. The wheels at the other end are prevented from rotating by a torque arm and a spring balance indicates the brake torque applied to them and transmitted through the differential. Temperatures are measured at various parts of the apparatus by means of copper-constantan thermocouples. For parts which are rotating, the leads are soldered to pairs of copper and constantan slip-rings. In this way frequent temperature measurements can be made at selected points in the wheel rim, the brake drum, and the brake lining.

It has been possible to indicate in this survey only the more outstanding of the tests in progress, but the full extent of the research work which has been completed can best be seen in the list of reports which have been prepared by the Laboratory. Among the latest of these are papers dealing with fuel economy and with the distressing phenomenon of brake squeak. In addition the research department abstracts and classifies technical information from English and foreign papers, and these abstracts and the full resources of the library are available to assist members in any technical problem or inquiry which may arise. In these ways the Laboratory is playing a most important part, and its new premises and equipment, used with the vigour that is apparent in its direction, give the assurance of even greater usefulness in the future.

PLANNING THE POST-WAR WORLD

IN his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. R. Beard reminded his audience that exactly twenty years ago, when chairman of the North-Eastern Centre of the Institution, he read a paper on "Post-war Conditions and Developments, with particular reference to the Electric Supply Industry". On re-reading it to-day, he found that purely technical achievement has fulfilled, and in many cases exceeded, the expectations then expressed. Where we have largely failed is in having no clear idea of the purpose for which these technical achievements should be used, and also in lacking ability to arrange that co-operation with non-technical people and interests which is necessary if the engineer is to produce the structure that he knows to be most efficient and useful to the community.

As a starting point, it is assumed that we all recognize that the War has brought about, and is bringing about, tremendous changes not only in our environment but also in our whole outlook on life, and that we are all prepared to agree with *The Times* that "To liberate Europe from Hitler does not mean to reverse the whole process of economic integration which has been set in motion. . . . Much harm may be done to our cause, both in Europe and oversea, by the insinuation that we stand for the old order and that our only aim is to restore the *status quo* in Europe and to maintain it at home. This charge should be emphatically and authoritatively refuted".

There is herein implied some, possibly belated, recognition that the old order is no longer producing a healthy and happy community and that, for one reason or another, apathy, selfishness and discontent, too much freedom in some directions and too little in others, were gradually undermining the character and vigour of the democratic nations. The malaise from which the democratic nations have been suffering is aptly summed up by the eminent American writer, Walter L. Lippman: "The muddle of the democracies comes from something deeper than their form of Government; it comes from the gradually accelerated destruction of all convictions about the nature of man and his destiny. . . . For how can this planet be governed by people who have ceased to believe that there is good and that there is evil ?"

Dorothy Thompson, another American writer, suggests that the primary origin of the War was the secession of Germany from Western civilization and that we are fighting a great civil war to force Germany back into it. She defines Western civilization as follows:

"It is not democracy, not parliamentary government and certainly not capitalism. All of those are merely manifestations of something else—temporary forms to express a more permanent content. Nevertheless, Western civilization is definable. It is the synthesis of three things: the Christian ethic; the scientific spirit; and the rule of law. The essence of the Christian ethic is that the weak have rights as well as the strong, and that the strong must set limitations on their own power. The essence of the scientific spirit is that the search for truth transcends the State and may not be limited or suppressed by the State. It presumes the separation of State and culture, that is, the separation of culture from force. The essence of the rule of law is that contract is superior to arbitrary force, it presupposes a continuity of relationships . . . from whose sovereignty no one is exempt, not the King, not the President, not the powerful, not the weak".

Mr. Beard concluded by considering electrical planning in the Empire. Where central or national generating authorities have been set up, the functions of supervision have usually been carried out by them—as in Eire, Victoria and most of the Canadian provinces. South Africa, Quebec and Southern Rhodesia have followed more closely the example of Britain in establishing a separate supervising authority, but on a narrower basis and with little control of municipalities. Similar bodies, with varying powers and functions, also exist in British India, New South Wales, Queensland and Kenya, but elsewhere in the Empire supervision is usually exercised directly through Government departments, which are in many cases primarily devoted to some allied activity such as local government or public works.

The variety of conditions under which electricity is generated is so great as almost to defy classification, but there has been a strong trend, particularly in the Dominions, towards some form of monopoly. For the most part this has resulted from the establishment of independent Government commissions,

of which Victoria, Ontario, Eire and South Africa are the best known examples, though there are smaller organizations such as the one in Trinidad.

Frequently a Government department has built and operated generating stations, gradually becoming a monopolist in the field of generation and bulk transmission. This has happened in such varied places as New Zealand, Western Australia, some Indian States, Malta and the Gold Coast. Over the rest of the Empire private and municipal enterprise dominate the field, though the trend towards monopoly is still clear.

In failure to take account of the difficult problems ahead lies our greatest danger. It is a danger specially to be guarded against by the younger electrical engineers, who must as years go on carry more and more of the responsibilities of the profession and whose lives will, to a great extent, coincide with the years of opportunity for the reconstruction of society and the building of a better world than they have inherited. These words of Sir Philip Sidney should be their inspiration : "It is the temper of the highest hearts to strive most upwards when they are most burdened".

ELECTRICAL AND MECHANICAL TRANSMISSION OF ENERGY

THE Andrew Laing Lecture to the North-East Coast Institution of Engineers was given on November 1 at Newcastle-on-Tyne by Prof. W. M. Thornton. He chose as his subject the foundations of the electrical and mechanical transmission of energy. From the earliest times men have sought to find the 'nature of things', and of the great branches of science into which their investigations have been gathered that of physics is both the most general and the most profound. It is essentially an experimental science ; but its greatest advances have been made by the use of mathematics. The applications of physics that form the scientific part of engineering have been the most effective when experiment and theory have moved together in rapid interchange, and in no part of the subject has this been more marked than in that which deals with the transformations of energy. It is only within this century that the identity of energy, for so long a subject of debate amongst scientific workers, has been firmly established. It is as real as matter itself.

The ten years between the discovery of X-rays by Röntgen in 1895 and Rutherford's establishment of the electrical constitution of matter have been described as the most fruitful in the history of science. To this amazing period we owe X-rays, the discovery of the electron, radioactivity, radium itself, relativity, the quantum theory of radiation, the development of radio-communication and the discovery that atoms are hollow planetary systems of elemental charges of positive and negative electricity, the proton and the electron. This last, together with the relation that is a consequence of the theory of relativity, namely, that matter is a form of energy, and hence mass, electricity and energy are convertible terms, places the doctrine of the identity of energy on a firm basis of reality.

In order to possess energy, the body or system of bodies in which energy is for the time located must either be in motion, in which case the energy that it has by virtue of its motion is called kinetic, or be part of a state of elastic strain, when it is termed potential energy or energy of position. A weight when raised acquires potential energy from the added electric strain of the ether of space that carries gravitational forces. In order that energy should be transmitted from one place to another it must be transformed from one of these states to the other, and the means by which this is in general done is the problem to which Prof. Thornton directed special attention. It is a problem of great theoretical and some practical interest. It is known that there is one law governing the whole range of the transmission of energy, whether in electric or mechanical engineering. This law is little known and is rarely referred to. Though occasionally used in the solution of electrical problems, it has never hitherto been applied to the consideration of those which deal with the transfer of energy by mechanical means.

There are problems of the transfer of energy which are met daily to which as yet there is no complete answer. How, for example, does a pendulum work ? At the end of its swing the energy is all potential, in the middle it is all kinetic. There is an almost perfect conservation of energy, but no one knows how the transformation takes place from the one form to the other. Its complete solution would require an understanding of the physical nature of gravitation and of the ether that has evaded scientific research from the time of Newton onwards.

One property of gravitational force that engineers may accept without question, though there are mathematical devices to evade it, is that to hold the planets in their orbits, it must be able to support great tensile forces. How these forces are derived physically from the matter of the sun and the earth is as yet unknown, though since matter is electrical in its constitution a gravitational field must have an electrical component in order to take hold of it. For many purposes the conception and use of this component is sufficient to illustrate the universal law which has been referred to, and on the assumption that all mechanical forces are electrical in their origin it may even be used to explain the working of a pendulum.

An equally familiar property of space is that it transmits radiation, from the extremely short and rapidly oscillating X-rays, through the regions of light and heat to the relatively long and slow waves of radio. These waves are in every case electromagnetic ; they all travel at the same speed through space, which we know to be the most perfect nonconductor of electricity, and in the case of radiation from the sun they carry the immense thermal energy by virtue of which life on this earth is possible. How this transmission of energy can take place through an insulating medium was shown some seventy years ago by James Clerk Maxwell, who based his electric theory of light on Faraday's discovery of magneto-electric induction and the polarization

or strain of insulating materials of dielectrics in an electric field of force. Maxwell's theory led in the end to the invention of radio, and brought the antipodes within reach of a telephone call. But even Maxwell, though he had found by mathematical analysis the velocity with which electromagnetic waves travel in space, that is, the velocity of light, and knew that both the electric and magnetic fields in these waves were transverse oscillations of the ether at right angles to one another, did not find or state the law connecting them and the mode of transmission of their energy. This was done some twenty years later by Prof. J. H. Poynting who, in extending Maxwell's theory, derived the simple and powerful relation known as Poynting's theorem or law. It is that everywhere in Nature, energy flows by the mutual reaction of electric and magnetic fields, that it is delivered in a direction at right angles to the plane containing both of them, and that the power is simply proportional to the product of the fields. The passage of every form of electrical or mechanical energy obeys this law, and now that we know that there is nothing in the material universe but electricity, it may even be regarded as one of the most illuminating physical relations in Nature, since electricity or electrification moves everywhere according to this rule.

A field of force in physics is defined as a state of stress that is in its origin electric or magnetic. It produces attraction between unlike charges or poles and repulsion between those of the same signs. A short account was given of Rutherford's electrical theory of the constitution of matter, pointing out that in the metal of a 2,000-ton ship there are a little more than a ton of electrons. For energy to travel there must be in every case, electrical or mechanical, an electric field and a magnetic field at right angles to it. Around and in an electric wire carrying a current there are two electric fields, one outwards or inwards at right angles to its surface through the insulation around the wire, and the other along the conductor commonly called the ohmic drop.

Modern high-tension cables have a cylindrical sheath of solid insulation of very high quality round the conductors which can easily carry an electric field of 10,000 volts per cm. This intense concentration of power is not in the wire but in the paper or rubber insulation surrounding it. Any electromagnetic energy that enters a metal never comes out of it except as heat, or in the case of machines, as mechanical stress.

At the end of a line where power is utilized there must be a relaxation of the electric field in order that energy may be transferred. There is no difference in principle between direct and alternating current transmission, for in the latter case both the electric and magnetic fields reverse together and the direction of the energy path does not change with that of the current. But if there is a difference in phase between the current and the voltage we have to multiply their product by the cosine of the phase angle to get the true power. Radio-transmission plays a large part in modern life and though the means by which it is done are highly technical and complicated, the movement of energy in free space once it has left the transmitter is relatively simple. The great masts and aerials that we see are in effect condensers to which very rapidly alternating voltage is applied. While a vertical antenna is being charged, in the millionth of a second, the current is moving upwards against the electric field that is piling up at the top, the direction of which is downwards.

When we come to consider the movement of energy in mechanical systems of transmission, we encounter the release of energy known as combustion. Sir William Ramsay was one of the first of chemists to realize the electrical nature of atomic forces.

Prof. Thornton concluded by carrying the general argument to its logical end. Before the coming of the electrical theory of matter, the highest flight of scientific imagination was to conceive a dead universe of cold worlds; but now we know that all that is necessary to bring it to an end, to uncreate it, is that the equal number of positive and negative charges that make up its atoms must be made to cancel one another out and 'leave not a rack behind'. But the energy that formed the universe will still remain, eternal and unchanged.

VISIBILITY AND ROAD ACCIDENTS

MOST research work on road accidents has been concerned with the physical or mental state of the driver of the car, but H. H. Ferguson and W. R. Geddes, in *Occupational Psychology* (**14**, No. 4), describe some recent work done in New Zealand on road accidents from a very unusual point of view. These writers investigated the beliefs of pedestrians regarding their own visibility, to see how far these beliefs compared with their actual visibility.

The method in outline was to get the subjects to walk along a straight, level, unlighted, open-country, dustless road, away from, or towards, the headlights of a stationary car. They had to indicate by pegs those points along the road at which they believed: (*a*) that it was just possible, but not likely, that they were out of the range of the visibility for the driver; (*b*) that they had a normal degree of certainty that they were just beyond the range of visibility for the driver; (*c*) that they were certain of being just outside the range of visibility for the driver.

It had been discovered that the greatest distance at which a typically attired moving pedestrian could be distinguished as a pedestrian with reasonable certainty was approximately 320 ft., while beyond 463 ft. nothing could be seen of the pedestrian.

When the results were analysed a wide range of distribution of distances was revealed. A considerable number of the subjects considered themselves to be visible when actually well beyond the range of visibility; one subject thought he was visible at 814 ft.

The authors hold that, if these findings were to be substantiated by further research, publicity should be given to this possibility of error, for the belief that one is visible when one is actually invisible is a dangerous belief. This is an interesting contribution to the complex problem of road accidents. If this possibility of error is important in New Zealand it is still more important in Great Britain, and particularly in black-out conditions.

NATURE

Vol. 146 SATURDAY, NOVEMBER 30, 1940 No. 3709

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

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Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, NOVEMBER 30, 1940 No. 3709

EDUCATION FOR THE FUTURE

IN his chapter on "Science and Free Culture" in his recent volume "Freedom and Culture", Dr. Dewey emphasizes the importance of developing the scientific outlook throughout a democracy, and not merely concerning ourselves in the general teaching of science with the dissemination of facts in particular branches of science. This attitude is a vital safeguard against wholesale misleading by propaganda, and is essential if science is to exert its real cultural effect.

The importance of this in education is very far from being realized, but Dr. Dewey is undoubtedly right in his firm warning about the dangers of any educational system in a democracy in which what is taught and how it is taught is not determined upon the basis of the formation of the scientific attitude. Unfortunately, there is little evidence that its significance has been realized in the various renewed attempts to deal with war-time problems of education which have recently been made. The Haining Committee appointed early this year to recommend how education could play its part in the welfare arrangements required during the coming winter does not appear to have paid any particular attention to science despite its importance in war itself.

Neglect of this factor is disturbing. It profoundly affects the mental alertness which is no less important to military efficiency than in civilian life. In fact, the two are so closely interlocked that the question of army education is one that may make a most important contribution to reconstruction after the War, particularly where rehabilitation and readaptation are concerned. Mr. Anthony Eden has emphasized the importance of education and welfare as a factor in keeping the Forces 'fighting fit'. The only real fitness is fitness of the whole man. A civilized nation in arms is a nation which continues to cultivate all its capacities of heart and mind, body and soul.

We may well regret that the Government was so long in making its decisions and that greater advantage was not taken of the months when relatively little actual lecturing and teaching could be done to develop the organization of the educational staff within the Forces themselves. There is still time to prevent the waste of another winter now the civilian bodies are thoroughly organized through the regional committees to meet whatever demand the Forces may make, and it is to be hoped that scientific workers themselves will not neglect whatever opportunities may be theirs in this way of spreading the scientific outlook and approach to problems of modern life.

It is equally to be regretted that in the fresh plans being formulated for the training of youth, there has been undue delay, and also there is no sign that the important safeguard which science can offer in this way against some of the most insidious dangers to democracy is yet realized. Mr. Ramsbotham's speech on October 16 went far to reassure the misgivings which had been engendered in some quarters by the proposals for the physical training of youth. There is no reason to fear that such training will be given an ex-military bias or emphasized at the expense of other sides of education, or that the day continuation scheme may be substituted for the raising of the school age. Mr. Chuter Ede, the Parliamentary Secretary to the Board of Education, explicitly declared that the suspended 1936 Act still represents the Government's policy.

There is no reason, therefore, to doubt that the Government's view of education is broad and

essentially sound. Mr. Bevin's vigorous and welcome language about educational reform indicates that there, at least, some of its members hold much more progressive views than some members of the House of Commons. We cannot, however, expect the commensurate Government action unless the House of Commons and public opinion behind it are really alive to the issues involved, and the onus for seeking to stimulate pressure for a more generous policy at the end of the War remains on those who are aware of its importance to the nation.

The raising of the school-leaving age to sixteen with satisfactory provision for continuation schools afterwards are only means to an end. They might prove as sterile as the youth movements of Germany and Italy, which are rightly shunned in Great Britain, if they do not receive the right educational content, wise use and inspiring leadership. The training of youth has to be approached in relation to the needs of youth, whether physical or recreational, as well as in relation to the needs of the community in which youth has to take its place. Peace-time industry no less than the needs of a nation in arms may make demands on the health of the adolescent inconsistent with juvenile welfare, and the consequent adjustments can only be made satisfactorily in the light of a real and far-sighted policy which is not obsessed with the immediate reactions or requirements.

Fundamentally, the training of youth to be successful must meet these requirements : it must produce leaders ; it must provide means by which youth can play its part in the national effort now ; and it must fit youth to take an adequate part not merely in a nation at war but also in the new world order to be established and in the building of that order. Those requirements can only be satisfied by a really long-range policy, broadly conceived, and embracing all the activities in welfare work and recreation, in industry and in military or naval life, which are shaping the youth of to-day and the leaders of to-morrow. Consideration of the content as well as of the manner of education is imperative and it essentially implies the introduction of a long-term national policy of scientific education.

Prof. J. H. Newton's recently published distinguished study of education for democracy* is of special interest in this respect because he goes far beyond the American conditions which are his immediate concern and lays bare the fundamental principles in the light of which particular conditions both in America and in Great Britain must be studied. From the outset he emphasizes two points : first, the relation of education to the society in which it occurs and the importance of education as an instrument for social control ; and second, the significance of the scientific method as an invaluable and indispensable method for the study of social and educational problems.

In regard to the first point, Prof. Newton refers to the constant pressure to which schools and teachers are now subjected by individuals and groups who seek to control education and direct it to the ends which they approve. The Tennessee statute forbidding the teaching of evolution is only one example of this tendency, but sufficient to show that freedom of teaching is in real danger even in a democratic State. Even the use of the schools for propaganda of the rational type, for social and moral reforms, is open to criticism and objection in view of the dangers attending it and the precedent it may afford for propaganda of a biased or anti-social type.

To object to such methods is not to assert that education has no concern for the shape of the society of the future or is without guidance as to the nature of the changes that must be effected. Education should prepare men to cope intelligently and effectively with the problems of their time. It is aimless and purposeless unless concerned both with the process of effecting changes and with the purposes to be achieved. The future citizen must learn not only how to think for himself but also how to act for himself, and teaching in which a teacher discusses practical problems without in the end indicating ways of approach is ineffective and incomplete.

All this, however, does not involve the teaching of a detailed blue-print for the new social order. Education is a social process that has social consequences, and it must at least aim at the building of minds sensitive to the social realities of the world in which they live, that are free, that have acquired the capacity of thinking for themselves, because they have had opportunity to think for themselves. This, however, in Prof. Newton's view, is insufficient. Education is also experience. It cannot be indifferent to the conditions in the social order that threaten freedom of thought, of speech and of Press and other democratic values.

* Education for Democracy in Our Time. By Prof. Jesse H. Newton. (McGraw-Hill Series in Education.) Pp. xv+242. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 16s. 6d.

Education must be deliberately planned for the achievement of purposes deemed desirable. In a democracy it must at least seek to foster loyalty to the ideals of freedom of inquiry, of thought, of speech, and of publication.

Prof. Newton points out that the process of education is not merely one of acquiring knowledge in the traditional sense. Knowledge is of fundamental importance, but the way in which knowledge is acquired and the aptitudes built up in the process are also vitally important. Youth must gain some understanding of the reliance of democracy on the methods of intelligence, on the most exact methods of assembling and verifying data for utilization in the formulation of policy, and practice in the application of these methods and techniques to critical social problems of concern to them. Effective understanding by youth of the intellectual bases of democracy and of the crisis in thought arising from the conflict between the two great systems of values in the contemporary world is essential if education is to serve democracy.

It is at this point that the scientific method and the outlook involved therein fulfil a further function. Besides promoting the understanding of the great social trends and problems of our time, they afford the only adequate safeguard against the dangers of propaganda. Some knowledge of the scientific method, the ability to assemble pertinent data, to scrutinize it carefully, to make the inferences and only the inferences that the data warrant, the ability to see relations, to look beneath the surface of things are imperative assets if individuals are to resist propaganda. Revolution in the content and methods of education might well be justified if it did no more than make youth aware of the propaganda beating upon it and gave youth the ability to detect it.

The handling of the whole range of problems associated with the training and welfare of youth on such lines and in this spirit would make a vital contribution at least to the building of the peace if not also to the winning of the War. On youth itself must fall a large share of the responsibility for bringing back to sanity and balance the youth of Germany, whose education for a decade has been distorted and perverted to barbarism. Only a youth whose feet have been guided to this point can be expected to throw up and loyally follow leaders of the wide vision and moral courage required to repair not merely the ravages of war, but also to reinvigorate our democratic system, give new inspiration and meaning to its ideals and work out more effective means of serving humanity.

Prof. Newton has given us a timely book though he barely touches on one live issue to-day raised in Mr. T. C. Worsley's somewhat uneven study of the public schools and implicit in Mr. Bevin's recent remarks regarding the admission of boys of the secondary schools to the diplomatic service. The undoubted value of the public school system in providing leaders should not blind us to the basic fact that the best ability for the service of the country, whether in diplomacy or in any other field, can only be secured by recruiting it from the widest possible area of selection. A system which divides the rising generation into two sections in accordance with the incomes of their parents is not only inimical to such selection but, no less important, creates a grave obstacle to effective co-operation in adult life between those who have been systematically segregated in youth.

Prof. Newton's chapter on equality of opportunity does indeed bear on this point, although he is considering the problem as it is presented in the United States. The social waste, however, to which he refers is to be found wherever lack of resources limits the educational opportunity. It is also a function of the economic and cultural level of the country in which the children live, and the reminder that schools controlled by a particular group in society, whether political or religious, or by a social class, will be bent to the purposes of that group or class is as pertinent to conditions in Great Britain as in America. The integration of the public schools into the educational system so as to eliminate the segregating influence of financial resources, whether by pursuing the idea of the Junior Local University propounded by Mr. Worsley, or in accordance with Dr. Middleton Murry's suggestions, is one of the most important contributions which could be made to the planning of education and the rebuilding of the social order. In education the broad view and the long-range purpose are all-important. It is indeed to be hoped that the attention now being concentrated on the training and welfare of youth may not be dissipated in mere palliatives or patchwork schemes designed to meet passing needs or difficulties, but rather issue in some comprehensive policy, boldly conceived and resolutely pursued, which shall bring new strength and vigour to our democratic institutions and win acceptance and respect for those ideals in the lands where the light of liberty is for the moment extinguished.

CONTACTS AND CULTURES

THE proposal to found in London a mosque and Islamic cultural centre (see p. 712) will be a cause of gratification not only to those whose more immediate needs will be served by such an institution, but also to all who will welcome the enlarged opportunities it will afford of contacts between East and West, and of the fuller understanding which, if it does not remove, will at least lower the barriers between peoples of different cultures, beliefs, and traditional outlook. The project has taken form largely owing to the personal interest and effort of His Excellency Hassan Nashaat Pasha, the Egyptian Ambassador in London, and from the beginning it has received the patronage of King Farouk. The extent of the support it will receive in the Moslem world may be gauged from the composition of the influential committee preparing the scheme. It includes representatives of the Moslems of Arabia, of Iraq and of India in addition to those of Egypt.

The good will towards the Moslem community displayed by the British Government in its response to the appeal carries on the tradition of tolerance amid a diversity of creeds and cultural traditions, which for long has been among the more notable characteristics of British imperial rule, and now has been passed on to the British Commonwealth of Nations. It comes at an appropriate moment. The minds of men, even amid the intense pre-occupations of a bitter struggle for existence, are already casting about for solutions of the grave problems of a post-War world. Then, if all goes well, the "New Order" of democracy (to adopt Mr. Roosevelt's phrase) will be confronted with the task of recasting the conditions of life of the whole world. Not again, if we are to profit from past mistakes, will the determination of racial, or national boundaries completely fill the foreground and middle distance of the picture. It is permissible to predict that where they appear, if appear they must, it will be in the true perspective of their subordination to the general interests of the whole and not solely of the component parts. World order will, in fact, have to be adapted to conditions, some of which will have suffered a profound change, while others will have to be remoulded drastically and to a new purpose to avoid the pitfalls of the past.

Already the President of the United States invites the Americas to a co-operation based upon a spiritual unity. In Africa, General Smuts foreshadows a Union of African States. Such a union should afford an ever-increasing opportunity for those ameliorations of the conditions of human life and progress on that continent on a scale, not indeed undreamed of, but hitherto beyond the resources of individual administrative units. In Europe the agreement between Poland and Czechoslovakia opens the way to a post-War nucleus of stability in Central Europe, such as might have been formed in Western Europe had not the proposed co-operation between France and Great Britain proved abortive. Even more suggestive, because of the implications of close personal and cultural contacts, are Mr. Bevin's plans for the forging of a new industrial link between East and West by bringing some hundreds of men from the workshops of India to receive a training in the workshops of Great Britain. Thenceforward not only will India be in a position to make great strides towards fuller development of her potentialities in contribution to the world's output, at the same time raising her own standard of life, but also closer contact between individuals of both peoples will have brought fuller understanding of the problems of each.

Except in so far as such proposals can be given immediate practical effect, it is too early to attempt to evaluate them. They will have to stand the test of discussion and experience; but if the past history of the British Empire affords any criterion, their prospect of securing stability and co-operation will depend upon the degree to which they are framed to allow free play to individual cultural and traditional differences. Just as the proposed mosque in London, with all the intellectual and cultural activities of Islamic tradition associated with it, will take its place in contributing to the life and functions of the capital city of the British Commonwealth, so racial and national traditions will not, or should not, vanish in post-War adjustment, but should be preserved, so that each may make its appropriate contribution in the advancement of the general good of mankind—a general good which is not "the greatest good of the greatest number" with concessions to minorities, racial or other, but a good which admits of liberty for the individual to attain full stature, intellectual, moral and social.

THE SYMMETRIC GROUP IN MATHEMATICS

The Theory of Group Characters and Matric Representations of Groups

By Dudley E. Littlewood. Pp. viii + 292. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 20*s.* net.

REPRESENTATION theory is a subject of many aspects, having important contacts with several branches of mathematics and mathematical physics. Even if text-books were much commoner than they are, there would still be room for an introduction to the subject so admirable as this. The very diversity of the theory demands a specialized outlook from those who write concerning it, but within the limits that implies, the account given by Prof. Littlewood is excellent.

From the point of view here taken, the core of the theory is Frobenius's formula for the characters of the symmetric group. The general theory for a finite group is first developed as far as the proof of the orthogonal relations, and there follows a detailed discussion of the symmetric group. Schur functions are also discussed in detail, partly for their own sake, and partly for their applications to the representation theory of continuous groups. This is dealt with in the last two chapters of the book. In the first of these the algebraic representations of the full linear group are found directly; in the second, the orthogonal relations for groups with closed manifolds are proved, and the characters of the unitary group and of the orthogonal and rotation groups are determined. There are also an account of spin representations, and a brief indication of the necessary modifications for groups leaving invariant an indefinite quadratic form.

The methods employed are chiefly those of Frobenius and Schur. Some use is made of the theory of linear algebras, but the problem of a synthesis of these points of view remains unsolved. The exposition is clear and concise; but occasionally a more explicit statement of what is being done might have helped. Thus, the work on pp. 51–52 amounts to a proof that any representation of a complete matric algebra is equivalent to a direct sum of identical representations, but this is nowhere stated.

The weakest chapter is an introductory one on linear algebras, which contains errors of fact. In particular, the assertion that the regular representation of an algebra is a simple isomorphism is made without the necessary proviso that the algebra possess a modulus. It is questionable whether the modern habit of including in advanced text-books chapters designed to make them self-contained is of real value. Certainly, a student who tackled the theory of characters without more knowledge of groups and matrices than can be given in such a chapter would be most unwise.

In a book dealing with a theory so largely formal as this, some errors inevitably escape the proof-reader's eye, but the number here is surprisingly small. Altogether, the book is a very welcome addition to the series of Oxford mathematical text-books.

GRAHAM HIGMAN.

GEOLOGICAL BACKGROUND OF ENGINEERING

Geology and Engineering

By Prof. Robert F. Legget. Pp. xviii + 650. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 22*s.* 6*d.* net.

"TRUE engineering is the attainment of the economic solution to the problems faced, and . . . the civil engineer seeks the co-operation of the geologist so that the best advantage can be taken of the rocks to be encountered. . . ." This quotation, which in the text refers to a particular branch of engineering construction, illustrates the author's point of view throughout his book. In order to demonstrate the value of geological and engineering co-operation, Prof. Legget has brought together for the civil engineer and the engineering student a large amount of well-illustrated descriptive material relating to engineering works, from many sources—American, British and Continental. It is one of the most valuable aspects of the book that the assembling of this data in one volume renders easily accessible a body of related facts which, in a border-line subject where science and art overlap and where no two works of construction are exactly alike, must otherwise be sought through an extensive literature.

The book is divided into two parts: an introduction to geology, and geology applied to civil engineering. The first occupies less than a tenth of the whole work and is scarcely sufficient to do justice to the subject; it seems to assume either some knowledge of geology on the part of the

reader, in view of the subsequent use of geological terminology, or a willingness to undertake further extensive reading. It is questionable, therefore, whether this short introduction really serves a useful purpose.

The second and major part of the book (which would be complete without the first) is subdivided according to different branches of the civil engineer's work; it is written in a readable style, against a background of practical experience. Beginning with a discussion of the general aspects of geology in relation to civil engineering, from the training of the student to the preparation of contract plans, the author rightly points out that "there is no special brand of geology applicable to civil engineering", but that a knowledge of fundamental geological principles should be an essential part of the civil engineer's training. Another chapter is devoted to a discussion of exploratory geological work at engineering sites, and deals, *inter alia*, with the question of costs, a matter not often referred to in a work of this kind.

Later sections cover a wide range of topics, including open excavation, landslides, tunnels, bridge foundations, reservoirs and dam foundations, ground water and water supply, building foundations, and materials of construction. Modern methods of applied geophysics are described, with notes on their uses and limitations in connexion with engineering works. The last chapter is headed "Soil and Soil Mechanics", but after a definition of the term 'soil' and a brief statement of methods of soil sampling and testing, there follows a lengthy discussion of rock weathering and glacial deposits, purely geological subjects which would properly belong to Part I; a fuller treatment of soil mechanics itself would be welcome. The modern outlook on clays and clay minerals is also summarized here.

The book concludes with a glossary, appendixes dealing with the geological surveys of English-speaking countries, geological societies and periodicals, and a valuable list of more than three hundred references to literature.

F. G. H. B.

WATER PLANTS

A Manual of Aquatic Plants
By Prof. Norman C. Fassett. Pp. vii+382. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s*.

NOTWITHSTANDING the relative uniformity of their environment, aquatic plants exhibit a remarkable variety of form and constitute a very distinct biological group comprising a considerable number of quite unrelated families. An extensive literature already exists relating to the special features of their morphology and ecology; but apart from monographs on certain genera, the group as a whole has not been analysed systematically with the view of simplifying identification. For various reasons the recognition of aquatic species is not always easy and the present work by Prof. Fassett is intended to make as simple as possible the identification of aquatic plants in sterile as well as in flowering or fruiting conditions. The species included in the Manual are those occurring in the region from Minnesota to Missouri and eastward to the Gulf of St. Lawrence and Virginia. Though the area is thus restricted, many plants are dealt with which are familiar to botanists outside America.

The book is planned so as to provide a series of diagnostic keys by which the student of aquatic biology should be able to identify such plants as he will be likely to find. The text is profusely illustrated by a large number of drawings, the author informing us that "the text is essentially a set of directions for looking at the pictures". The number of illustrations cannot be stated with any exactness since they are not numbered consecutively, but, somewhat inconveniently, in groups varying according to the size of the family. The keys to the Cyperaceæ, for example, are accompanied by 210 figures. Some idea, however, of the wealth of illustration may be gained from the fact that more than half the number of pages are devoted to drawings. They constitute, indeed, a noteworthy feature of the book, and the habit drawings and those showing details of flower and fruit structure are all equally clear and nicely done.

The text of the volume is divided into two parts, Part 1 (pp. 3–35) being a general key for the identification of the family or genus though occasionally it may lead to the actual species. Detailed treatment is given in Part 2 (pp. 36–341), a few pages being devoted to cryptogams before the phanerogams are taken. Vegetative characters are largely used in the construction of the keys, and this has the advantage of directing attention to the features of the whole plant rather than to floral characters alone. The number of species, together with varieties and forms, is surprisingly large in a book which bears the title it does, and Prof.

Fassett has evidently experienced difficulty in deciding where to draw the line between aquatic and terrestrial. For his present purposes he defines an aquatic "as a plant that may, under normal conditions, germinate and grow with at least its base in water and is large enough to be seen with the naked eye", a definition which must inevitably raise difficulties regarding the selection of species. The author admits that the list is highly subjective and that no two botanists would be likely to draw up the same list of species. Many of those included are plants of swamps or wet situations by the margins of lakes or rivers. The bog habitat is said to be excluded, though not a few plants find admission which do, in fact, occur in bogs.

An appendix gives a brief but useful statement regarding the use of aquatic plants by birds and mammals, and the volume concludes with a glossary and index. J. R. Matthews.

AMERICAN APPLIED SYLVICULTURE

Applied Sylviculture in the United States
By Prof. R. H. Westveld. Pp. vii + 567. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 25*s.* net.

THIS book may be regarded as one of the most informative works on some important branches of forestry which has appeared. Carefully prepared for the United States and profusely illustrated, Prof. Westveld's work will well repay a study far outside that country. This is not a treatise on sylviculture pure and simple; the word 'applied' in the title is doubtless intended to correct such a diagnosis.

The author divides his book into eighteen chapters, as follows: i. North-east spruce—hardwood region. ii. New England white pine region. iii. Oak region. iv. Allegheny hardwood—pine—hemlock region. v. Southern Appalachian region. vi. Southern Pine region. vii. Southern Bottomland hardwood region. viii. Central hardwood region. ix. Lake States region. x. Douglas Fir region. xi. Northern Rocky Mountain region. xii. Lodgepoke pine region. xiii. Southwest Ponderosa pine region. xiv. California pine region. xv. Northwest Ponderosa pine region. xvi. Black Hills Ponderosa pine region. xvii. Redwood region. xviii. South-eastern Alaska. The method of treatment of each of these chapters is on similar lines, as follows: *Description:* Location and land ownership, physiographic features, climatic features, development of lumbering, effect of past practices. *The Forests and their Management:* composition and character, stand regeneration and development, windfall, utilization and marketing problems, growth and rotation, financial aspects, application of sylvicultural methods, slash disposal and effects, disease and insect problems, control of animal and logging damage.

Some of the above heads and investigations go beyond the definition of sylviculture as understood in Europe, or, we may add, India, where a correct forestry practice has been in force for nearly eighty years. It might be suggested that even 'applied' sylviculture should not include such distinctive branches of forestry as protection and utilization.

The varied nature of the forestry problems the United States have to face is evidenced by the total areas shown in each of the above chapters as occupied by forests, either national forests, forests owned by the individual States, and those in private ownership—from the great lumbering organizations and other forest-owning private bodies and individuals down to the small farm-lot woodlands.

A very rough analysis of areas gives the following interesting figures. Total area of forests and forest lands (the latter of a varying type in degrade) is approximately 601 million acres. The national forests occupy approximately 150 million acres; the forests of the several States approximately 19 million acres, whilst 432 million acres are occupied by the various categories designated as private forests.

The most informative and fascinating parts of the book are the author's treatment of the sylvicultural problems confronting United States foresters. The forester in India is well aware that, owing to the diversity in climate, typography, and so forth, sylvicultural methods and operations will require different treatment in accordance with the varying conditions and species, etc. The same is true in the United States, with the proviso that conifers (instead of broad-leaved species as in India) cover the preponderating area of the forests, and that lumbering, disastrous fires, and large areas of second-growth forest of very varying uniformity in growth introduce an added complexity to sylvicultural values and their study and treatment. Prof. Westveld has dealt with these problems in a most instructive fashion.

E. P. Stebbing.

FOOD PRODUCTION IN GREAT BRITAIN AND IN WESTERN EUROPE

By Sir John Russell, F.R.S.,
Rothamsted Experimental Station

INFORMATION about food production in Great Britain is readily obtainable from the excellent volumes of statistics issued by the Ministry of Agriculture and the corresponding body in Scotland. Hitherto it has been difficult to compare these results with those obtained in Western Europe; the data of course existed, but they were scattered through many volumes in a variety of languages, and as they were not necessarily comparable there were many pitfalls for the unwary student. Agricultural statistics are particularly troublesome things to handle. The difficulty is largely met by a recently published book by Mr. P. Lamartine Yates, which comes at a most opportune time*. The material was assembled and checked on an agricultural journey in 1938, and both the author, and Lord Astor and Mr. Seebohm Rowntree, who were the prime movers in the enterprise, are to be congratulated on its accomplishment.

Mr. Yates deals exhaustively with the Western European countries, France, Belgium, Holland, Denmark, Sweden and Germany, and in his final chapter makes the comparisons with Great Britain. The section on France is particularly interesting, written with understanding, even affection, but faithfully. He recognizes the Frenchman's intense individuality and his dual loyalty to his *pays* or province, and to his *patrie*, France; while these qualities have played their part in the recent *débâcle* they would put serious difficulties in the way of reorganization on German lines with the French as a *race asservie*. One thinks of France as being more agricultural than England and Wales and so far as population is concerned this is true, but not in regard to the use of the land; more land in Great Britain is devoted to agriculture than in France or Germany. The figures are given in Table 1.

Table 1.
Land utilization per cent of total area.

	England and Wales	France	Germany
Agriculture	67	60	61
Forest	6	20	27
Waste and rough grazing*	14	10	4
Non-agricultural uses	13	7	8

* Waste in France and Germany; rough grazing in England and Wales.

In northern France the chief crops in order of importance are wheat, oats, lucerne, the root crops, potatoes, mangolds, sugar beet, usually grown in a three- or six-course rotation; wheat, oats, lucerne; wheat, oats, roots; less than a quarter of the land is in permanent grass. In the south cereals occupy only about 25 per cent of the arable land, as against 60 per cent in the north, and many special crops are grown: vines, fruit, vegetables, tobacco and maize; some 60 per cent of the land is in permanent grass by reason of its elevation. As in other countries the arable land tends to go down to permanent grass.

France produces about 90 per cent of its wheat requirements, against about 15 per cent in Great Britain; but the yields are lower than in the latter. Potatoes are widely grown far exceeding human requirements, and quantities are fed to pigs; sugar beet is much more localized. As in Great Britain, sheep fell greatly in number after high levels between 1876 and 1896; but the rise which began about 1920 has not gone so far as in Great Britain. Cattle, on the other hand, increased almost continuously in number, and before the War were higher than ever before. Pigs had fallen greatly in number during the War of 1914–18, but rose steadily and before the War were almost at the best of the earlier levels. About 50 per cent of the farmed land is held in 25–125-acre holdings; about 20 per cent in holdings of less than 25 acres and 30 per cent of more than 125 acres. Large farmers are found mainly in the arable regions of the north.

German agriculture is, of course, very different. An east-west line drawn through Cologne, Dresden and Breslau divides Germany into two parts; to the north is the low-lying, almost featureless sandy plain that travellers to Berlin and Warsaw often found rather tedious; to the south are mountains, uplands and forest. The soil of the northern plain is rather poor. In the eastern part the farms are large; 1,000 acres is a usual size, but 10,000 acres is not uncommon. Only some 10–20 per cent of the land is in grass by reason of the low rainfall; rye and potatoes are the chief crops; the potatoes are both for human consumption and for industrial

* Food Production in Western Europe: an Economic Survey of Agriculture in Six Countries. By P. Lamartine Yates. Being the Report of an Inquiry organized by Viscount Astor and B. Seebohm Rowntree. Pp. xv+572+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15s. net.

use, and most of the large farmers have their own distillery or starch factory. In north-west Germany farms are small, 50–300 acres, but prosperous; dairying is the chief industry, based on grassland near the coast, and on arable crops farther inland in Westphalia. The south-west is mainly in small holdings; it is a rich country producing fruit and vines, poultry, pigs and milk. Central Germany, the Anhalt region, including Magdeburg and Halle, has larger farms and much sugar beet, while Bavaria produces much milk on its arable plateau and grassy uplands. The utilization of the land is almost the same as in France, excepting that forest occupies 27 per cent and waste only 4 per cent.

Sixty per cent of the arable land in Germany was (1937) in corn, 22 per cent in roots and 11 per cent in temporary grass; for Great Britain the figures are 50, 25 and 25 per cent respectively (fodder crops and fallows are included with the roots); a typical rotation is roots, corn, corn, which may be followed by grass, corn, corn; for example, on the northern plain one often finds potatoes, rye, oats, but rye is the commonest grain crop occupying $10\frac{1}{4}$ out of the 28 million acres of grain; it is much better suited to the sandy soil than wheat. As in other countries, there is a tendency to lay down arable land to grass. Since 1914 the percentage of the farmed land used for arable crops has fallen from 75 to 68. Yields of grain are approximately the same as in Great Britain—wheat is a little less, so are potatoes, but yields of sugar beet and hay are higher. Much more labour and fertilizers are expended per acre than in Great Britain, but there is less manuring through the animals than here. Up to 1930 some 25–30 per cent of the animal food was imported as in Great Britain, but since the Nazis came into power great efforts have been made to dispense with importations and substitute home-grown food; considerable success has been achieved. Numbers of livestock are less then they were before the War of 1914–18, sheep indeed having decreased drastically. Pigs are the chief meat producers, furnishing about two thirds of the nation's meat requirements; there are 25 million of them compared with less than 4 million in Great Britain.

The rural population has for years past been falling, but since the advent of the Nazis the fall has greatly increased. At first farm workers were forbidden to leave the land; but in 1936, when industry was short of labour, this prohibition was withdrawn, and during the next three years nearly a million workers went. Then, however, the decree was reimposed and indeed strengthened; the workers in 1939 were practically tied to their occupations. Concurrently efforts were made to reduce the need for labour by increasing the amount of machinery available. There was always a seasonal labour deficit and this was made up by importing farm workers from Poland, Czechoslovakia, Yugoslavia and Italy; the Nazis disliked it because they considered the farm should be a "Germanic entity", free from alien elements. It would be interesting to know how the farms stand now in this respect. In order to ensure a continuance of peasant farming the Farm Inheritance Act of 1933 provided that farms of peasant size could not be sold or subdivided, nor could the owner borrow money on the security of the land; he is in effect tied to his land as it is tied to him. Peasant owners must be racially pure, politically reliable and technically efficient. The heir need not be the eldest son; often indeed he is the youngest.

The agriculture of the smaller and until recently, freer and more productive countries, Denmark, Holland, Belgium and Switzerland is described in "Food Production in Western Europe" in detail, and as one reads the accounts one realizes the depth of the tragedy that has overwhelmed them. All these countries had attained high levels of technical skill and output, but the systematic

TABLE 2.

FOOD CONSUMPTION IN LB. PER HEAD PER ANNUM. (P. LAMARTINE YATES).

(1934–38)

	Great Britain	Denmark	Netherlands	Belgium	France	Switzerland	Germany
Bread and flour*	197	198	200	250	280	200	222
Potatoes	210	264	—	440	400	198	398
Sugar	109	120	58	62	56	97	56
Beef and veal	66	53	39	40	46	55	34
Pork	48	72	50	45	20	48	65
All meat	143	125	91	90	74	108	100
Milk (gall.)	20	36	26	20	23	58	21
Butter	22	17·2	14·5	20·6	13·3	14·3	16·4
Margarine	8	45	15	10	—	—	15·5
Cheese	9·5	12·1	14	6·4	12·5	18·5	12·6
Eggs (No.)	153	90	100	236	149	156	126

* In terms of flour.

TABLE 3.
AGRICULTURAL OUTPUT 1937. (P. LAMARTINE YATES).

	Output per worker, £		Wages per hired worker, shillings	Acres per worker	Stock units per worker	Output per acre*, £	
	Gross	Net				Gross	Net
Great Britain	240	200	30–36	33·8	10·3	7	6
Denmark	180	155	23–26	15·7	8·4	11	10
Netherlands	150	120	23–30	9·0	4·9	17	14
Belgium	110	100	18–22	7·4	3·4	15	14
Switzerland	110	100	27–29	7·1	4·3	17	15
France	90	90	20–28	11·6	2·8	8	8
Germany	70	70	18–23	7·9	2·8	8	8

* Rough grazings in Great Britain reckoned at half their average, and Alpine grazings in Switzerland at one quarter.

plundering to which Denmark, Holland and Belgium are now being subjected will gravely impoverish them for years. They were far ahead of Germany in output per man and in output per acre. Unfortunately, their prosperity aroused Nazi covetousness and proved their undoing. In pre-War days they had sent Great Britain quantities of food, notably butter, eggs, bacon, early vegetables and certain fruits. In war-time these supplies are all cut off. and so far as they still exist are deflected to Germany. But much of the intensiveness of their agriculture was due to the importation of large quantities of feeding stuffs and fertilizers, most of which are no longer obtainable ; their output will therefore be considerably lowered.

British farmers have a much more difficult task than confronts the Continental and particularly the German farmer. The peace-time dietaries of the Western European countries are stated by Mr. Yates as in Table 2.

The English dietary included considerably more meat (especially beef and mutton), sugar, butter, fruit and vegetables than the German, but only half the potatoes and 12 per cent less bread. On average British yields, 1·6 acres are necessary to produce the food of the British consumer unit ; the limited land area can at this rate feed only 40 per cent of the British people. The German dietary, on the other hand, requires little more than half this land per head, and as Germany has twice the area of agricultural land that Great Britain has, but less than double the population of the latter, it is not surprising that they can attain more than 90 per cent of self-sufficiency against 40 per cent in Great Britain. Indeed the more one studies the two systems the more one realizes how superior the German is for war-time. Moreover, the details have been well worked out. Thus in spite of the fact that the pig is the most economic transformer of food into meat, Great Britain will have to reduce her pig population while retaining her sheep and cattle, because pigs consume food suitable for milk production or for human beings, while sheep and cattle do not. The German farmer will be able to keep many of his pigs, for a system of feeding has been worked out that requires much less concentrated food. Other technical difficulties had also been met ; indeed so long as the Germans can draw forced labour and agricultural produce from surrounding countries they cannot be starved out, although they can be made uncomfortable.

The British farmers' activities have been in quite a different direction. In the years that followed the War of 1914–18, when but little interest was taken in agriculture, the farmer's task was to survive and to meet the rising costs of wages resulting from the competition of industries moving southwards. He solved the problem by increasing his own efficiency and that of the workers. Mr. Yates's figures showing the relative output per worker in the different countries' areas are given in Table 3.

The net output of the British agricultural worker is three times that of the French or German ; the gross output is still higher. No other European country begins to equal Britain in this respect. But this high output per man has not given us high output per acre. In some ways the two things are opposed, and countries of high output per man frequently have low output per acre. The relation, however, is not rigid, and it is possible to achieve high output per acre and high output per man ; that is the problem now confronting British agriculturists. There is no evidence that it can be done simply by enlarging our farming units ; the countries that far surpass us in output per acre are all lands of small holders. But there is also no evidence that the setting up of small holdings would give any better result ; in spite of considerable public expenditure on small holdings the numbers have continuously shrunk. The reorganization must be in the direction of making fuller use of the technical and scientific knowledge now or in future available so as to increase the efficiency of the land as well as that of the worker. The crux of the problem lies in the uncertainty of prices of agricultural produce. Farmers have to start

spending money on crops and stock many months before the produce can be sold, and in the meantime prices may have fallen considerably. Farmers cannot take indefinite financial risks and must play for safety. No other producers of commodities are in so insecure a position; all, except farmers, are always protected by contracts.

A similar arrangement seems indicated for agriculture. The total food requirements of the nation are fairly accurately known; it should not be difficult to allocate them to the various supplying countries and so to settle what should be the share of the British farmer. Contracts could then be made; the farmer to supply specified quantities, and the buying agency to pay specified prices which should move, however, with wages, since these are fixed by statutory bodies. Arrangements of this kind have for some time been in force for milk, sugar beet and wheat, and have led to the adoption of improved methods and increased output. The same principle is being tried for meat, a much more important farm product. Of course, it means a certain amount of planning, but this seems inevitable in our national life after the War. Our fundamental problem will be to reconcile planning with the liberty which none of us would be prepared to give up, but this certainly should not prove insoluble.

ANCIENT MESOPOTAMIA AND THE BEGINNINGS OF SCIENCE*

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THE thesis which it is proposed to outline here embodies the following propositions: (1) Available evidence points to Mesopotamia as the oldest known centre of scientific observation permanently recorded. (2) Whatever its immediate objectives, this activity comes to include such widely separated fields as education and language study, jurisprudence, and the mathematical and natural sciences. (3) The numerous elements in this broad advance are interrelated basically. The common underlying factor to which the initial impetus can be traced is a concept of society whereby the powers of the State are restricted and the rights of the individual receive a corresponding emphasis. (4) It is significant that under the opposite social system of totalitarian Egypt early scientific development differed in scope as well as in degree; while notable in certain special fields, such as medicine and engineering, it lacks the breadth and balance manifested in contemporary Mesopotamia.

There were certain features in protohistoric Mesopotamia which tended to encourage scientific progress. The results happen to constitute the first recorded evidence of scientific performance known to us to-day. To this extent we are justified in touching here upon the beginnings of science, including the natural sciences. But it should be made clear at the outset I am concerned not so much with the results as with the background; a combination of circumstances conducive to concerted activity rather than the subjects affected by that activity. The background gives us in this instance the essential starting point; it is thus more significant than the immediate achievement.

Our interest, then, centres on a particular cultural stage at which there were at work forces that led to extensive scientific developments; forces which provided the predisposition, so to speak, to these developments. Accordingly, we shall ignore such sporadic achievements of a still more remote age as the invention of the wheel, the introduction of the brick-mould, and perhaps the use of instruments in effecting accurate geometric designs on very early forms of painted pottery. We may have here Mesopotamian inventions which were to play important parts in the eventful progress of engineering, architecture, and perhaps geometry; but these inventions represent isolated contributions of discontinuous cultures which scarcely had any immediate bearing on scientific progress.

The region to which our inquiry will take us is Lower Mesopotamia, the land of ancient Sumer. More specifically, it is an area extending southwest from the environs of Babylon, past Uruk—the biblical Erech—and on along the Euphrates to the metropolis of Ur. The time is the middle of the fourth millennium B.C. This is not just a convenient round figure. It will allow a margin of scarcely more than a century, and in a total of more than five thousand years this is not a disproportionate margin of error. We are in a position to establish the time with such accuracy because

* Substance of a paper read at the Bicentennial Conference, University of Pennsylvania, on September 16.

it falls within a well-stratified cultural period marked off sharply by distinctive material remains. Soon after there begin to appear inscribed records which link up before long with concrete regnal years and provide thus a basis for absolute chronology.

We get our first inscribed documents from a level dated to shortly after 3500 B.C., one of a long series of strata recovered from the remains of ancient Uruk. It is among these documents, written on clay, that we find a few which represent the earliest known scientific records. That similar records of still greater antiquity will ever turn up outside Mesopotamia is highly improbable. All available evidence points to the conclusion that the scientific notations with which we are concerned were compiled in close association with the introduction of writing itself. To be sure, this evidence applies only to the script of Mesopotamia. But writing in all the other ancient centres of civilization is demonstrably later. In Egypt it was introduced some centuries after it had been evolved in Mesopotamia, and its first appearance in India was later still. As for the script of China, there is nothing to indicate that it was earlier than the second millennium B.C. It follows, therefore, that the scientific notations on our earliest Mesopotamian tablets constitute not only the first evidence of scientific activity in Sumer, but represent also the oldest recorded effort of this kind known from anywhere in the world.

What is it that would justify the use of the term 'scientific' as applied to a few of the oldest inscribed documents from Mesopotamia ? The answer is bound up with the character and purpose of these special texts. Each of them contains lists of related entries. But these lists have nothing in common with the customary inventories of a strictly economic nature. They serve an intellectual rather than a material purpose ; and yet, they are to enjoy a continuity and distribution which will set them off sharply from the usual run of business documents the significance of which is at once temporary and local. The lists in question are destined to be copied and recopied for many centuries and in more than one city and country. Actual examples of such copies, often modified and expanded, but still in a clear line of descent from the oldest prototypes, have been discovered in Mesopotamian sites of much later age, and even in foreign capitals like Elamite Susa. We have thus before us the beginning of a family of documents of a scholarly character which are notable for their continuity, distribution, and purposeful adherence to an established tradition[1].

In this recording of accumulating experience and the manifest applicability of such records to the needs of cultural centres separated by political, linguistic, and chronological barriers we have the essential ingredients of scientific performance. Now what science or sciences did this activity embrace ? We shall see presently that the primary purpose of the lists under discussion was to aid in the preservation of the knowledge of writing. Before long, philological studies become an added objective, owing largely to the composite ethnic and linguistic background of early historic Mesopotamia.

Natural sciences, too, soon get attention. For regardless of the primary purpose of these lists, they happen to include quite early in their history groupings of birds, fish, domestic animals, plants, and the like. It is worth stressing that these compilations presuppose careful observation and imply organization and analysis of the accumulated data[2]. As an element in the cumulative tradition of the land the lists are subject to steady expansion and improvement. What is more, although these texts were calculated originally to serve purposes unrelated to their subject-matter, they lead in course of time to the independent study of the subject matter involved. The fields affected are zoology and botany, and later on geology and chemistry. The first recognition of all these subjects as so many separate fields of study may be traced back, therefore, to the earliest inscribed documents from Mesopotamia.

The subsequent progress of the individual sciences just mentioned has to be traced by specialists. We are concerned at present with the initial impetus alone, and the time and circumstances in which that impetus was first received. A few details, however, may be brought out in passing. In the light of the foregoing remarks botanists will not be surprised to learn that many of the terms which they use to-day are found in Mesopotamian sources. These terms include cassia (cuneiform *kasû*), chicory (*kukru*), cumin (*kamûnu*), crocus (*kurkânû*), hyssop (*zûpu*), myrrh (*murru*) nard (*lardu*), saffron (*azupirânîtu*), and probably many others. The zoological compilations which are accessible in cuneiform records contain hundreds of names systematically arranged and presented in two columns, the first giving the Sumerian term and the other its Akkadian equivalent[3]. The scholastic tradition in chemistry results in such texts as the one which has come down to us from the second millennium B.C., wherein a formula for glazing pottery is preserved in the guise of a crypotogram so as to remain hidden from the uninitiated[5]. The importance of natural science for the study of medicine is self-evident ; it was not lost on Babylonian and Assyrian medicine.

So much for the indirect benefits derived from the lists under discussion. But the primary

objective of these compilations was not allowed to suffer in the meantime. On the contrary, the direct results which were achieved with their aid led to an immensely fruitful advance in another field of intellectual progress.

It was stated above that the lists were intended as a means of preserving the newly attained knowledge of script. By the very nature of its origin in concrete pictographs, early writing was an elaborate medium consisting of thousands of items. To each new prospective user it represented a code which could not be deciphered without a proper key. The lists were calculated to supply that key. They were analytical catalogues of signs arranged according to form. Inasmuch as each sign was at first a reflection of something specific in the material world, these catalogues were at the same time systematic groupings of related objects; hence their incidental value to the natural sciences, as we have just seen. The immediate purpose, however, of these arrangements was pedagogical; they are our oldest manuals for the discipline of education. As pictographs and ideograms gradually took on abstract phonetic values, the study of the script became linked perforce with the study of language. After the Semitic-speaking Akkadians had joined the Sumerians in building up the civilization of Mesopotamia, linguistic studies rose to exceptional heights against this bilingual background.

The foregoing outline shows that many forms of scientific progress in Mesopotamia were influenced and linked together by a scholarly tradition which was in turn the by-product of the invention of writing. Our survey has failed, however, thus far to include mathematics and astronomy, two fields for which Mesopotamia has long been celebrated. It need scarcely be said that these subjects were affected no less than the other disciplines by the same forces which made for a broad cultural advance in general. But the primary cause of the extraordinary development of mathematical and related studies in Mesopotamia is to be sought, I believe, in conditions which antedate the introduction of writing. In fact, I would add, the origin of writing as well as the interest in mathematics are to be traced back, in this case, to a common source. This source will be found inherent in the society and economy of the prehistoric Sumerians.

We know to-day that the Sumerians got their idea of writing from the cylinder seals which they engraved with various designs to serve as personal symbols. These symbols came to be employed as marks of identification for religious and economic purposes, for example, with temple offerings. In this representational function the old designs develop into concrete graphs for humans, animals, plants, and so forth, and thence for temples, gods, and cities. The graphs are then associated in each instance with specific words. The gap between picture and word is bridged. Gradually means are devised to express not only complete words but also component syllables, the advance leading thus from the concrete to the abstract. At length writing is perfected to function as a flexible medium for the recording of speech and thought[5].

When we look back now on the successive interlocking stages in this complicated process, which has been sketched here in its barest outlines, an interesting fact will emerge. The early Sumerians had not set out at all to invent writing. They were carried to this result by a combination of peculiar circumstances.

We have seen that the immediate ancestor of Mesopotamian writing was the cylinder seal which was first and foremost the Sumerian's mark of ownership. Impressed on clay or cloth it served to safeguard in the eyes of god and man one's title to possessions or merchandise. We have here a clear indication of a strongly developed sense of private property and thereby of individual rights and individual initiative[6]. The curious shape of the cylinder seal, original with the Sumerians, is explained by its use as a mark of individual ownership. For such cylindrical objects are well suited to cover uneven surfaces with their distinctive design[7].

Wholly consistent with this economic origin of writing is the fact that the earliest written documents are given over to temple economy. Later texts branch out into the field of private business. Both these uses testify independently to the importance attaching to property rights. Records of a non-economic character are the last to appear, except for the lists discussed above, which served as direct aids to writing. The first inscribed documents were used, accordingly, for economic ends, precisely as the cylinder seals themselves. It is easy to understand why the oldest pictographs were so often identical with the designs on the seals.

It follows that Mesopotamian writing, and hence the first script known to man, was the unforeseen outgrowth of a social order which was founded on a recognition of personal rights. This basic feature of Sumerian society is attested overwhelmingly in cuneiform law, perhaps the most characteristic and the most abundant expression of ancient Mesopotamian civilization. In the last analysis this law rests on individual rights. It is not surprising, therefore, that proof of ownership becomes a vital necessity under this system. Incidentally, the rigid requirement of such proof is the main reason for the hundreds of thousands of legal documents recovered from the buried sites of

Mesopotamia; the forces responsible for the introduction of writing continued thus as the primary factor in the subsequent popularity of script. The law applies to ruler and subjects alike. The king is at first no more than a 'great man', as is shown by the Sumerian etymology of the term as well as the form of the corresponding pictograph. He may become the administrator of a vast empire; but even then he is still the servant, not the source of the law, and is responsible to the gods for its enactment. There is here no encouragement of absolute power. Law codes are the constitution which guides the ruler and safeguards the subjects. We have seen that this system is capable of promoting cultural progress on an extensive scale. Its inherent vitality is evidenced by the ease with which this order maintains itself for thousands of years in spite of a succession of political changes under the Sumerians, Akkadians, Gutians, Babylonians, Kassites, and Assyrians. Nor is further expansion hindered by ethnic or linguistic obstacles in its path; for distant and heterogeneous outsiders are attracted not infrequently to the orbit of the Mesopotamian civilization. Among the newcomers we find the Elamites, the Hurrians, and the Hittites, the last-named a people of European ancestry and Indo-European speech. Incidentally, it is to the influence of Mesopotamia upon the Hittites that we owe to-day our oldest available records of any Indo-European language. The newcomers proceed to copy the laws, use the script, and enjoy the other benefits of the adopted civilization.

Enough has been said to imply that mathematics and time-reckoning were bound to prosper against this social and economic background. An obvious corollary is preoccupation with metrology, with the result that Mesopotamian weights and measures spread eventually beyond the domain of the parent culture[8].

To sum up, there existed an intimate relation between scientific progress in Mesopotamia and the source of historic Mesopotamian civilization. Underlying all was a social order resting on the rights of the individual, embodied in a competitive economy, and protected by the supreme authority of the law. This system brought about the evolution of writing, henceforward a decisive factor in the advance of civilization and its diffusion past the changing ethnic and political boundaries. We have here the essentials of a truly cosmopolitan civilization, notable for its assimilatory power and a science broad in scope and balanced through the inner unity of its many branches.

Would this story of scientific development have differed appreciably under another type of civilization? The answer is hinted at in one of history's most magnificent experiments. The one centre possessing a culture of comparable antiquity but dissimilar social and economic background was Egypt. Here the king was a god and as such the absolute ruler and titular owner of all that his realm contained. Under this concept of government there was no room for the recognition of private ownership of property and the all-embracing power of the law. The pharaoh was dictator of a State genuinely and thoroughly totalitarian. The pyramids bear lasting and eloquent testimony to his enormous authority.

We are not concerned here with the respective merits of two contrasting forms of government. Our interest is confined for the present to the effect of co-existent civilizations upon the progress of science in the two centres under comparison. The perspective of more than five thousand years cannot but deepen our appreciation of the debt which modern life owes to both Egypt and Mesopotamia. By the same token, however, we are able now to view objectively some of the differences between their respective achievements.

The established superiority of Mesopotamian mathematics may be attributed, in part at least, to the stimulus of the local economy, so different from the Egyptian. Opposed concepts of property ownership and the fundamental rights of the individual were responsible for the intensive pursuit of legal studies in the one instance and their subsidiary role in the other. The astounding accomplishment of Mesopotamia in the field of linguistics had no adequate counterpart in Egypt. Now we have seen that in Mesopotamia progress in linguistic studies, not to cite now other branches of science, was linked intimately with the development of writing. But was not Egyptian writing a correspondingly potent factor?

If this question cannot be answered with complete confidence it is largely because the origin of the Egyptian form of script is still open to conjecture. Some details, however, are certain and beyond dispute. The earliest inscribed records of Egypt are some centuries later than the first written documents of Mesopotamia. In Sumer we can follow the successive palæographic stages step by step, whereas in Egypt the formative period of writing seems to have been very short indeed, to judge from the available material. Moreover, writing left in Sumer a clearly marked trail which leads back to a specific social and economic set-up; in Egypt there is no such demonstrable relationship. Because of all these facts, and in view also of commercial and cultural links known to have connected Egypt and Mesopotamia at the very period under discussion, it is logical to assume that Egypt imported the idea of writing from Mesopotamia. Differences in the form and use of the signs would correspond, then, to the existing

differences in the art and languages of the two cultural centres. On present evidence, any other assumption would leave far too much to coincidence[9]. In the final analysis it is not so much a question of the mere use of script as of the conditions responsible for the original emergence of writing.

At all events, Egyptian writing, regardless of its origin, inevitably played its part in the notable progress of Egyptian science. What we miss here, however, is the scope and inner unity of scientific advance which are found to be so characteristic of Mesopotamia. That unity was the product of a tradition which is traceable ultimately to a particular concept of life. In totalitarian Egypt a different set of values attached to life and government and tradition. Is this the reason for an effort that seems more sporadic, greater perhaps in its power of concentration on specific objectives, but also more conspicuous for its omissions ? Over a period of millennia this appears to be a justifiable comparative appraisal of the results achieved in the field of science by the two oldest historic civilizations.

[1] These facts are brought out clearly by A. Falkenstein, whose "Archaische Texte aus Uruk" (Berlin, 1936) is the basic work on the earliest documents from Mesopotamia ; cf. especially pp. 43 ff.
[2] Careful observation is evidenced also by the accurate drawings of the early pictographs, particularly where exotic animals and specific plants were concerned.
[3] See Benno Landsberger (in co-operation with I. Krumbiegel), "Die Fauna des alten Mesopotamien" (Leipzig, 1934).
[4] On this subject see R. Campbell Thompson, "A Dictionary of Assyrian Chemistry and Geology" (Oxford, 1936).
[5] R. Campbell Thompson and C. J. Gadd, in *Iraq*, **3**, 87 ff. (1936).
[6] Cf. E. A. Speiser, "The Beginnings of Civilization in Mesopotamia," *J. Amer. Oriental Soc.*, Supp. 4, **59**, 17 ff., esp. 25–28 (1939).
[7] See H. Frankford, "Cylinder Seals" (London, 1939), p. 2.
[8] Note the article by V. Gordon Childe, on "The Oriental Background of European Science", *Mod. Quarterly*, **1**, No. 2, 105 ff. (1938).
[9] Cf. Speiser, *op. cit.*, 22, note 12, and Siegfried Schott, in Kurt Sethe's "Vom Bilde zum Buchstaben" (1939), pp. 81 ff.

BROADCASTING IN INDIA

THE task of providing an efficient radio broadcasting service in the Indian Empire is beset with many problems which are peculiar to that country and which other broadcasting organizations in Europe and America have not encountered. India is a country of relatively great distances and a vast population, most of whom have a rather low standard of living. Nearly thirty times the area of England, the population numbers more than 300 millions, speaking some 200 different languages, of which about 16 are in common use. From a technical point of view India is subject to a frequent and very high atmospheric disturbance level, and this calls for special consideration in the choice of wave-length and power of the transmitting stations, if a satisfactory programme service free from interference is to be obtained. Furthermore, it was clear many years ago that a broadcasting service could not be built up out of licence revenue as was done in Great Britain. These and other problems have occupied the attention of the Government of India over the past thirteen years, since the first broadcasting station was opened at Bombay by Lord Irwin in July 1927. In his speech on this occasion the Viceroy indicated that India offered special opportunities for the development of broadcasting, and that although it was then in its infancy, he had little doubt that, before many years had passed, the numbers of its audience would have increased very considerably and that this new application of science would have its devotees in every part of India.

The long and varied struggle which the Indian State Broadcasting Service has had since the date mentioned above is recounted in a recent publication from Delhi entitled "Report on the Progress of Broadcasting in India, up to the 31st March 1939"*. A second broadcasting station was opened at Calcutta in 1927, by the end of which year the number of licensed listeners was less than 3,600. Although this number was soon doubled, the rate of increase remained sensibly unaltered from 1929 until 1932, when the inauguration of the Empire Service of the British Broadcasting Corporation led to a sharp rise in the rate of increase to more than 16,000 listeners by the end of 1934, although there were still in operation at this time only the two broadcasting stations already mentioned. Soon after this time, the first Controller of Broadcasting of the Government of India assumed charge of the organization known as All India Radio, and set to work to develop broadcasting into a service appropriate to the needs of the country. In view of the lack of technical experts in India with any long experience in broadcast engineering, considerable assistance was obtained in this connexion from the B.B.C. in Great Britain.

The development policy, upon which work has been actively progressing during the last two or three years covered by the report, envisaged the establishment of nine medium-wave stations and five short-wave stations, one of which, situated at Delhi, was specially assigned for the transmission of news from a central point. The basis of the scheme of using medium-wave stations operating on wave-lengths between 200 and 400 metres followed the experience gained in Europe and

* Report on the Progress of Broadcasting in India up to the 31st March 1939. Pp. xiv+230+21 plates. (Delhi: Manager of Publications, 1940.) 3 rupees; 5*s*.

America, and it was considered that the nine stations projected would provide a first-grade medium-wave service at important centres of population. In order to reach the rural population, however, it is necessary to spread the service over relatively great distances and this factor, together with the prevalence of some atmospheric disturbances, led to the supplementary scheme of the provision of short-wave transmitting stations. The application of short wave-lengths to Indian broadcasting differs in one very important aspect from the application made by European countries, in so far as in India the short-waves were required for an internal broadcasting service, whereas in European countries the short-wave service is primarily intended for overseas listeners. This difference in requirements leads to the use of different wave-length bands in the two cases, and therefore fortunately to an absence of interference. The Indian short-wave stations normally operate in the day-time in the wave-length bands of 30 and 49 metres, which are used by the European international stations only at night; while in India at night, the wave-length bands of 60 and 90 metres are utilized, and these are not used by broadcasting stations operating an international service.

At the inauguration of the above scheme, it was estimated that if the short-wave transmitters were of a power rating of 10 kilowatts they would have an intelligible, if not satisfactory, service range of about 500 miles. The four stations projected for general use could therefore be regarded as covering the whole of India, and providing a service which, if not entirely free from fading, would be not unsatisfactory to the average listener. The installation of four such stations instead of one high-power medium-wave station possessed a marked advantage in providing the possibility of alternative programmes which, owing to difficulties arising from timings, languages, Indian and European music and so forth, would clearly be very desirable. During the years 1937 and 1938 the four short-wave stations came into operation, and these, together with the new and already established medium-wave stations, resulted in twelve of the fourteen projected stations being in service use at the date of presentation of the report referred to above. The whole scheme was financed by a capital grant from the Government of some £300,000, from which a balance of about £120,000 remained on April 1, 1939. The overall annual expenditure of the All India Radio organization has risen steadily to nearly £190,000 for the year 1938–39.

In the early days, the engineering and technical control of broadcasting in India was conducted by the Posts and Telegraphs Department. Afterwards these activities were transferred to All India Radio under the Controller of Broadcasting, in order to avoid the admitted difficulties of divided control between administration and programmes and engineering. Considerable space is given in the Controller's report to the activities of the Engineering Department, which is concerned mainly with the maintenance and operation of existing broadcasting stations; the planning and installation of new broadcasting centres; and with development and research work of a technical nature.

Any broadcasting system must make extensive use of direct connexions between the various stations so that programmes originating at one station may be radiated from others. These connexions are usually effected by telephone lines suitably designed and installed for the purpose; but in India they present a special problem owing to the immense distances separating the broadcasting stations and the general unsuitability of the telephone lines and associated apparatus. All India Radio has consequently developed a system of wireless links whereby each broadcasting station is provided with a receiving centre equipped with special directional aerials for accepting programmes from the desired stations. These receiving centres are used principally for picking up the short-wave transmissions of All India Radio and of the B.B.C., and relaying these from the local transmitter. In the same way the news bulletins of the Central News Organization at Delhi will, as receiving centres are established, be received and relayed by all stations in the system. The main receiving centre on the outskirts of New Delhi was installed and working on a temporary basis just in time to relay the Coronation ceremony broadcast by the B.B.C. in May 1937. The installation utilizes a combination of three directional aerials for diversity reception to minimize the fading commonly experienced in short-wave broadcasting. The New Delhi receiving station also acts as a main control centre where a watch is kept on the wave-length, field strength and quality of the transmissions from stations of the All India Radio.

Among the more important activities of the research department of the organization is a study of the field strength of the transmissions from the various stations and of the service area of each station as determined by the ratio of the field strength of the signal to the strength of the disturbing noise. Much useful material on these subjects is given in the report under discussion, but only one or two outstanding points can be referred to here. One interesting fact emerging from the measurement of the field strength of the radiation from the various medium-wave stations is that the decrease in intensity of the ground wave with increasing distance from the

transmitter shows that the conductivity of the soil in India is of the same order as that obtained under average conditions in England (that is, between 1 and 2 × 10^8 E.S.U. or 4,500–9,000 ohm-cm.). In addition to a study of ground wave conditions, measurements have also been carried out at night time on the indirect ray field strengths of the medium-wave stations. The results show that, with one or two exceptions that remain for further investigation, the relation between distance and field strength of these stations approaches the curve published by the C.C.I.R. (International Committee on Radio Communication), which is based upon a very large number of measurements made by broadcasting organizations in various parts of the world. This fact indicates that the conditions of medium-wave propagation through the ionosphere in India are not appreciably different from those in other parts of the world.

As already mentioned, the effective service area of a broadcasting station is determined by the ratio of the strength of the wanted signal to that of the unwanted noise. During the summer months of May–October, atmospheric disturbances represent the greatest single technical difficulty to be met with in India in providing a satisfactory broadcasting service, especially on the medium wave-length band. It is natural, therefore, to find that a considerable study is being made into the nature and origin of atmospheric disturbances. It is interesting to observe, however, that on the short wave-length bands, the service area of the Indian broadcasting stations is at present limited by the noise from electrical machinery and not by atmospherics. By far the most serious limitations on short-wave reception in India is the noise resulting from the operation of ceiling fans from a direct-current supply. In practically every city in India a D.C. supply only is available, and only in the large cities is a gradual change-over to alternating current supply being made. During the summer months, for a greater part of the twenty-four hours, there is a number of D.C. motor-driven fans in operation, and in many of these the commutator is in an unsatisfactory condition and hence causes serious disturbance.

As a conclusion to this review of the present state of broadcasting in India, reference will be made to a somewhat unusual activity of a broadcasting organization, namely, the design, supply and maintenance of a communal receiver for use by a considerable proportion of the rural population. From what has been stated earlier in this article it will have been appreciated that, apart from a few towns and suburbs, the broadcasting service in India is maintained by means of indirect rays propagated through the ionosphere, and if all-the-year-round reception is desired, the receiver must be one of the short-wave type, which is by no means cheap. The bulk of India's population live in villages, and it is considered that nearly 99 per cent of them cannot afford to buy any radio receiver, however reasonable its cost may be. The only solution to this economic difficulty appeared to be the installation of community receivers and the provision of special programmes for the villages. A number of such receivers has been installed by, and maintained at the expense of, the Governments of the individual provinces and are very successful.

As a number of difficulties were met with in the earlier stages of the inauguration of the village receiver scheme, a study of the technical points involved was made by the Research Department of All India Radio. After adequate investigation of the requirements, a specially designed receiver was evolved which, while following the general trend of commercial practice, incorporated certain additions and modifications. The receiver is of a straightforward superheterodyne type suitable for operation from a 6-volt car accumulator. In the comparatively few cases where an alternating current electric main supply is available a suitable alternative type can be provided. The two main requirements involved in the design of these receivers are reliability of operation and economy, since it is desired that they shall work automatically with only occasional attention by skilled technical personnel.

The receivers themselves are mounted in padlocked metal boxes, designed to keep out dust and insects. No controls appear on the outside of the box, and the receiver is left tuned to the local station. A clockwork-driven time-switch, incorporated in the set, switches the receiver on and off at the correct time for the "Village Hour" of broadcasting. Special attention has been given to the loud-speaker, which has been designed to have a high electrical acoustical conversion efficiency, to be free from the ravages of dust and moisture, and to give an adequate output of reasonable quality suitable for an audience of some two hundred listeners. The present type of receiver can be run from a medium-size car battery for a month on the basis of one hour's listening per day. Every three or four weeks the battery is charged and the clock re-wound. Installations of this type varying from fifteen to a hundred and twenty receivers in various provinces are in process of completion. In this manner, the full possibilities of community listening in numerous villages are being explored in an attempt to make broadcasting available to as great a proportion of the population of India as possible.

NEWS AND VIEWS

Islamic Culture in London

The announcement by Mr. G. N. Hall, Under-Secretary of State in the Colonial Office, in the House of Commons on November 13 that the Government at an early opportunity would invite Parliament to vote a sum not exceeding £100,000 for the purchase of a site for the erection of a mosque and centre of Islamic culture is one which has caused intense gratification to Moslems in Great Britain, and will be deeply appreciated throughout the Moslem world. The need has long been felt for an adequate centre of this kind at which Moslems in Great Britain might offer their prayers, develop Islamic culture and preserve their religious tradition. His Excellency Hassan Nashaat, Egyptian Ambassador in London, in announcing the gift by broadcast in Arabic "to my brothers in Islam" as reported in *The Observer* of November 17, appealed to the Moslem world for a sum of £500,000 towards the building fund, having previously given an assurance that this great centre of Islamic culture would belong to the whole Moslem world and would be controlled by its representatives irrespective of sect or denomination. The gift from the British Government, as was suggested in a reply by Mr. Hall to a supplementary question, in a sense is reciprocal to a gift from the Egyptian Government some years ago, when the site for a cathedral was presented to the British community in Egypt.

Conditions in Air Raid Shelters

The committee appointed jointly by the Minister of Health and the Minister of Home Security in September last, under the chairmanship of Lord Horder, made its first recommendations within a few days of its appointment and has continued to give advice from time to time. Further recommendations, with brief statements by the Ministry concerned of action already taken, have now been issued (London: H.M. Stationery Office. 2*d.* net). The Committee states that the crux of the problem is overcrowding, which should be countered by popularizing the domestic and communal shelters, and also by vigorously pursuing evacuation schemes already in operation. The other recommendations refer mainly to the provision of amenities, such as bunks, lighting and sanitary arrangements, and of first aid posts. On the thorny question of heating, the Committee points out that it is closely related to ventilation. The ideal solution would be air-conditioning, but as this is not practicable, ventilation by natural means is assumed. All ventilation shafts and other means for the entrance and exit of air should obviously be kept free, and floor draughts should be controlled by arranging for incoming air to be admitted at high levels so that it may mix with warm air. Shelters liable to crowding do not require heating even in winter, but sparsely occupied shelters might be heated during the latter part of the day-time. Air-borne infections may be reduced by spraying with a solution of sodium hypochlorite, and innoculation against diphtheria should be encouraged. A simple form of face mask would help to prevent the spread of droplet infection by coughing and sneezing.

Psychology in War-time

It is reported by Science Service that at a recent meeting of the South Psychiatric Association held at Jacksonville, Florida, Dr. C. Charles Burlingame, of Hartford, Conn., discussed the Nazi utilization of applied psychology in warfare. Dr. Burlingame pointed out that Hitler is mentally abnormal, but because he is a hysteric, it must not be assumed that his thinking is not lucid; for he has successfully used the psychological factors of modern warfare to produce mass depressions and mass anxieties in whole nations. In dealing with him, the statesmen of the world have made the grave and tragic error of assuming that he was a normal man, whereas almost any psychiatrist would have known that he could not be expected to function or react in a normal way. Psychology can, however, make a positive contribution to the task of ridding the world of Nazism. In times of war, all the paranoid trends come to the surface; in other words, the primitive brain which supplies the drive and co-ordinates the activities, but lacks the ability to formulate abstract principles, is apt to take charge. This is shown by outbreaks of persecutions and terrorism; such outbreaks are a sign of weakness. Germany will grow progressively weaker as her hatred grows stronger and then suddenly transforms itself into despair and depression. It is the duty of psychiatrists to ward off such outbreaks. They can also watch for possible social gains in times of war; many youths whom medical men would classify as 'unstable' might find a new life in the Army, where under intelligent discipline, with security and regular direction, they may become useful citizens.

Production of Feeding-Stuffs in Great Britain

Supplementing his study of Britain's supplies of feeding-stuffs from all sources (see Nature, Sept. 14, p. 362), Dr. Norman Wright has investigated quantitatively the problem of making good war-time deficiencies by using new sources of indigenous materials and by improved conservation of all supplies (*Agric. Prog.*, 17, Pt. 2). He finds that conservation of all slaughter-house offals would only just offset the greatly diminished supplies of fish-meal, and that large-scale utilization of kitchen waste would provide a mere fraction of our requirements. Of greater significance is the officially projected production of one million tons of grass silage, but this amount would involve the construction of about 30,000 silos, each of 30–35 tons capacity; and if ten per cent of the straw not used for stock-feeding were converted into a digestible cellulosic feed by predigestion with alkali, more than 20,000 digestion tanks and about 22,000 tons of caustic soda would be required.

Neither the direct use of urea or ammonium bicar-

bonate to make good the protein deficiency in cereal and other starchy foods, nor the doubling of the existing acreage under beans, would appreciably add to our resources in protein materials. More hopeful would be the economizing of imported feeding-stuffs by adopting the Lehmann system of pig-feeding (restricting the cereal meals and using more boiled roots, potatoes, etc.); the reduction in the protein ration of dairy cows from 0·6 lb. to 0·5 lb. protein equivalent per gallon of milk; and by putting all poultry on minimum feeding allowances. These savings would represent about three times those to be secured from possible new sources of supply. The total savings from all sources would represent 11·7 per cent protein equivalent and 8·9 per cent starch equivalent of our pre-War home production, but only 8·5 and 6·9 per cent, respectively, of our total pre-War supplies.

The Pharmaceutical Society's New House

The Pharmaceutical Society's building in London was nearing completion when the exigencies of the War brought about a suspension of the final stage of the building operations, and so prejudiced the intention of celebrating the centenary in a new home. The council of the Society, having in mind the fact that the lease of the old building in Bloomsbury Square will expire in due course, is approaching the Ministry of Works with the proposal that, in return for facilities being granted to finish the building, the Government should have the option of the use of it during the present emergency. This offer may raise the general question of the attitude of the Government regarding large modern buildings in London which are nearing completion.

The Society's new building has a frontage of 235 ft. and a site depth of 120 ft.; it is designed to provide a basement, ground floor and five upper stories, and the total available floor area which could be provided would be more than 141,000 square feet. The main front block and the west and centre wings have been erected up to the fourth floor level. The east block remains to be built from above basement level. The building is of steel frame construction with panel walls finished on the outside in brickwork with stone and slate dressings; the floors are of reinforced concrete. Since the accommodation contemplated covered the provision of laboratories, two lecture theatres, an assembly hall, library, refectory with kitchen and administrative offices, there are available large open and well-lighted floor areas readily adaptable to office or other similar requirements.

Germany's Aluminium Industry

The *Engineer* is publishing a series of illustrated articles entitled "Air Force Targets in Germany", in which much information is given about the docks, harbours, canals, factories, railways and power stations which are so often in the news. Three of the latest articles to appear, published respectively on October 18 and 25 and November 1, deal generally with Germany's aluminium industry and especially with the large works at Lauta, to the north-west of Dresden, at Bitterfeld in the Leipzig district and at Rheinfelden in the extreme south-west of Germany. The last is the oldest works, having been started in 1898, while the other two were planned in 1915–17 to meet the needs of the time. Each of the works consist of three main sections; an electric generating and transforming station, factories housing the groups of electrolytic baths or furnaces and foundries in which the metal is cast into ingots and bars and rolled into sections and sheets. The raw materials needed for the production of one ton of aluminium are 4 tons of bauxite, 80 kilos of artificial cryolite, about 600 kilos of carbon electrodes, and some 23,000 kw. of electric energy. The process time varies from 100 to 130 hours. In 1929 Germany's output of aluminium was 33,000 metric tons out of a world total of 282,000 tons and by 1938 it had risen to 163,600 tons out of a world output of 579,900. More than 70 per cent of Germany's light alloy manufacturing capacity is Government owned, and every effort has been made to extend the use of these light alloys and to manufacture them from home-produced raw materials.

Telegraphic Typesetting

A paper on telegraphic typesetting by H. H. Harrison read and discussed before the Institution of Electrical Engineers appears in the *Journal* of the Institution of October. In the discussion, Mr. D. Murray pointed out that the paper is valuable because it reminds us that, in addition to strong stream and weak stream technique, there are controlling electro-mechanisms of the most remarkable character, correctly described as electrical typewriter-keyboard machines, of great complexity and beauty. The teletype, one of these keyboard machines, of which the fundamental characteristic is the transmission of intelligence by semi-mechanical machines (telegraph class of mechanisms), is in wide use in the form of a telegraph exchange, analogous to a telephone exchange, covering the whole of the territory of the United States, with about 15,000 subscribers. Considerable progress was being made in this direction in Great Britain also, and plans were being considered for spreading the exchange all over Europe. Unfortunately, this development has been interrupted by the War.

Mr. Harrison's paper deals with an astonishing extension of the telegraph-keyboard mechanism that combines the typewriter-keyboard mechanism with typesetting at a distance. Mr. Murray saw it in operation at the Western Electric Teletype factory in Chicago about three years ago. It was shown to him as an example of successful prophecy, because about forty years previously he had exhibited a typewriter telegraph of this class at the old Astor House in lower Broadway with the slogan "This tape sets type". He had brought the model from Australia and it attracted much attention. In his reply, Mr. Harrison said that Mr. Murray's forty-year-old prophecy was an interesting example of the slow growth of ideas. Although the Monotype keyboard producing a perforated tape and provided with an

integrating counting mechanism was then available and was also as remotely situated from the type producer (the caster) as the present telegraphic typesetter keyboard, yet it is only comparatively recently that telegraphic typesetting has been accomplished.

Reducing Noise in Enclosed Spaces

DURING the last two years, progress has been made in the problem of noise reduction, especially in sound-proofing rooms against the transmission of external noise. In *Engineering* of October 25 the allied problem is described of sound-proofing rooms by using Accousti-Celotex tiles of sugar-cane fibre, manufactured by Messrs. Celotex, Ltd., Stonebridge Park, London, N.W.10. Under present-day conditions, many offices, etc., are more congested, with resultant increased noise. It is of interest, therefore, to cite certain data on sound absorption in offices which have recently become available. They are derived from tests made in the offices of an insurance company in the United States. This company has had about 300,000 square feet of Accousti-Celotex tiling fitted to its offices. Records were kept for a year preceding the fitting of the tiles and for a year after they had been installed. In two selected rooms, the increase of efficiency of the persons working therein was respectively 9·2 per cent and 7·7 per cent. Typists' errors were reduced by 29 per cent, and calculating machine operators' by 52 per cent.

It would appear that apparent loudness or annoyance increases much more rapidly at the higher loudness levels (in phons) than it does at the lower sound-levels, with the result that a relatively small reduction in phons at the higher levels decreases the apparent loudness very considerably. Thus it was found that a 7-phon reduction in a typing room with an average maximum loudness of 70 phons results in a decrease of 43 per cent in the apparent loudness or real annoyance, which condition is equivalent to the effect gained by the removal of about 80 per cent of the noise-making units. It is of interest to note that the tiles, from the material employed, are of light weight and are not affected as regards their sound-absorbing properties by painting. The grade of tile fitted in any particular case varies with the amount of noise normally present and the amount of absorption desired.

Mineral Resources of South Africa

THE Executive Committee of the Third Empire Mining and Metallurgical Congress, which met in South Africa in 1930, prepared for the Congress a review of the mineral resources of the Union of South Africa. The success which attended the issue of this book led to its revision in 1936, and now, in 1940, the Department of Mines has published a third and again thoroughly revised edition. Introductory chapters deal with the geography and geology and with various historical and legal aspects of the mineral industry; but the bulk of the work, which extends to 544 pages, is devoted to individual economic minerals, of which the chief, in order of total output, are gold, diamonds, coal, copper ores, tin ores, asbestos, silver ores and the platinum metals.

Recent expansion of mining activity in the case of gold has led to results which indicate that former estimates of the future life of the goldfields were below the true figure. The opinion now expressed is that unless gold materially decreases in value, the future of gold mining in South Africa is secure for many decades to come. Diamond mining has recently been almost at a standstill, apart from the alluvial fields; existing reserves are sufficient to maintain normal production for nearly a century. Similarly, there are immense reserves of platinum in the Bushveld complex, and when prices become more favourable a great expansion of this branch of the industry is inevitable. Of coal and iron the Union possesses vast resources, coal being sufficient to provide for the needs of the country for many centuries. The book is copiously illustrated and well provided with maps and statistical tables, and will prove to be of great interest to a wide variety of readers.

Indian Association for the Cultivation of Science

THE annual report for the year 1939 of the Indian Association for the Cultivation of Science includes as an appendix a report by Prof. K. S. Krishnan on the scientific work of the Association. This has included investigations on the magnetic properties of a free-electron gas with the view of determining the energy distribution, and Pauli's observation of a feeble paramagnetism independent of temperature in the electron gas has been verified for several metals. Landau's discovery of the appreciable diamagnetism of an electron gas has been experimentally verified, and recent measurements by Prof. Krishnan and Mr. N. Ganguli have shown that the conductivity of graphite in the basal plane is at least 10,000 times that along the normal to the plane. Other investigations have related to the mobile electrons in aromatic molecules, the diamagnetism of aromatic molecules, optical studies on aromatic molecules, magnetic studies on bismuth in the neighbourhood of its melting point, and paramagnetic studies on single crystals of the salts of the rare earth and the iron groups of metals, as well as structural studies on organic crystals, including the halogen derivatives of benzoquinone and related compounds. Notes on some spectroscopic work on the sulphides of the transitional group of elements and on the discovery of a new ionization layer in the upper atmosphere are also included.

Replenishing the Fauna of the Caspian

As a first measure to replenish the fauna of the Caspian—a problem on which the Soviet Ichthyological Research Institute has been working for some years—Nereis, the Polychæte worm relished by the sturgeon, bream and other fish, is to be brought to this land-locked sea from the Azov. The worm will be transported from the Azov Sea in isothermal boxes and put into the Caspian. Experiments carried out during the past three years have proved the

possibility of transplanting certain species of invertebrates from the Azov to the Caspian. The Ichthyological Research Institute has decided to begin with the transplantation of Nereis, which is able to withstand changes in salinity and temperature and is unaffected by lower contents of oxygen.

Wilhelm Erb

Prof. Wilhelm Heinrich Erb, a pioneer in neuropathology and electrotherapy, was born at Winnweiler in the Palatinate on November 30, 1840. He received his medical education at Heidelberg, where he was assistant to Nikolaus Friedreich, and qualified in 1864. After working with Buhl at Munich on morbid anatomy, he was appointed extraordinary professor of special pathology and treatment at Leipzig in 1867 and full professor in 1880. Three years later he was transferred to the corresponding chair at Heidelberg, where he remained until his retirement in 1917. His first work was in connexion with toxicology, histology and therapeutics, but afterwards he devoted himself almost entirely to neurology. Erb's name, either alone or in association with those of other neurologists such as Duchenne, Charcot and Goldflam, has been given to several nervous diseases. He was also the first to describe the knee-jerk, independently of Westphal, and simultaneously with Fournier demonstrated the close etiological association between syphilis and tabes and general paralysis. He died on October 29, 1921.

The Night Sky in December

On December 22 the sun enters the sign Capricornus (the winter solstice). The night reckoned from sunset to sunrise then lasts 16¼ hours in the latitude of London. Full moon is on December 14 and new moon on December 28. At meridian passage soon after 0h. on December 15 at Greenwich, the moon's altitude is 57°. Jupiter and Saturn, the conspicuous pair of bright planets, are visible throughout the greater part of the night. On December 11, they are in conjunction with the moon at 1h. and 6h. respectively. (All times are given in Universal Time; add 1h. to convert into Summer Time.) Mars is a morning star rising about half an hour before Venus on December 15. These two planets are in conjunction with one another on December 2 at 12h. On December 25 at 18h., Mars is in conjunction with the moon, and Venus is likewise in conjunction on December 26 at 18h. The rapidly changing positions of Jupiter's four inner satellites, their transits and eclipses, may be followed from the data given on p. 630 of the *Nautical Almanac* or on p. 182 of *Whitaker's Almanack*. Saturn's unique ring system is well open; a refractor of 2 inches aperture or larger is, however, required to resolve the rings. The bright stars of Perseus, Auriga, Taurus and Orion (with Procyon and Sirius in train), bring glory to the December night skies. There are the open star clusters of Perseus, the Pleiades and the Hyades: many well-known double stars, variable stars and nebulæ in abundance. Near φ Tauri is a dark nebulous region which Barnard considered as giving the strongest proof of the existence of obscuring matter in space. Near the irregular variable star, *T* Tauri, is the remarkable object known as Hind's variable nebula. Two notable nebulæ, exemplifying two distinct types, are both visible to the naked eye on moonless nights during this month. These are the great nebulæ of Orion and Andromeda—the first a greatly extended diffuse nebula of radiating gas lying within our Milky Way system: the second, a vastly remote stellar system in itself, the prototype of many millions which are shown on long-exposure plates taken with the largest reflecting telescopes. At midnight on December 31–January 1, 1941, Sirius, the brightest star in the heavens, is within 2 minutes of the southern meridian of Greenwich.

Announcements

During a recent air raid, the Great Hall of the University of Bristol was damaged. The Great Hall is one of a series of magnificent buildings presented to the University by Sir George Wills and Mr. H. H. Wills, in memory of their father, the first Chancellor, and opened by King George V in 1925.

It is announced in *France*, the journal for Free Frenchmen published daily in Great Britain, that Prof. P. Langevin, who has just been awarded the Copley Medal of the Royal Society (see Nature, Nov. 23, p. 679) is now in prison.

Dr. G. Roussy, rector of the University of Paris and formerly dean of the medical faculty and professor of pathological anatomy, and M. Maurice Guyot, general secretary of the University, have been removed by order of the Vichy Government.

Dr. D. H. Peacock, professor of chemistry in the University of Rangoon and special chemical adviser (Customs) to the Government of Burma, is retiring from the service of the Government of Burma.

Dr. Dontcho Kostoff, of the Institute of Genetics, Academy of Sciences, U.S.S.R., has been appointed to a position in the Central Agricultural Experiment Station at Sofia, Bulgaria.

Mr. Harold Hartley has been appointed lecturer in mine surveying in the University of Leeds, in succession to Mr. T. Brown, resigned.

Mrs. J. R. Ogden and her family have presented to the Brotherton Library of the University of Leeds a large collection of lantern slides. These, added to the slides given by Mr. Ogden during his lifetime, bring the number in the Collection to more than five thousand. The slides deal largely with Palestine and Egypt, and include more than four hundred slides on the tomb of Tutankhamen.

It has been found necessary to close the Museum of the Royal College of Surgeons until further notice. Those who wish to present specimens to the Museum should retain them in their possession, but should notify the Curators of their intention to present them at a later date.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

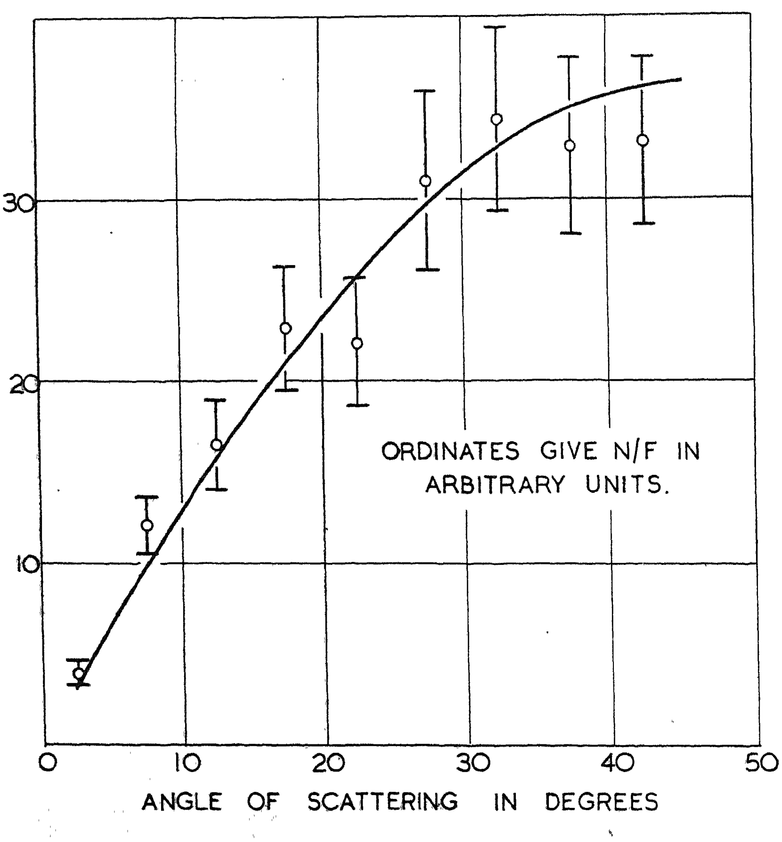
Neutron-Proton Scattering at High Energies

THE angular distribution in the scattering of neutrons by protons has been investigated by a number of observers, particularly Dee and Gilbert[1], using neutrons with an energy of approximately 2·0 eMv. It is now generally agreed that the scattering is isotropic about the centre of the mass of the colliding particles with neutrons of this energy. We have recently investigated the scattering at much higher energies, using the 8·7 eMv. group of neutrons coming from boron under deuteron bombardment.

In a recent communication[2], one of us (C. F. P.) has shown that it is possible to measure the angle of dip of a proton track in a photographic emulsion relative to the plane of the emulsion, and hence to determine the spacial orientation of the proton track, with an accuracy of $\pm 1°$. Attention was directed to the fact that this technical advance makes it possible to apply the photographic method to the determination of the spacial distribution of the protons arising from the photo-disintegration of deuterium by a directed beam of monochromatic γ-rays, and to the investigation of neutron-proton scattering at high energies. For the present experiments we passed the neutrons from a highly localized source, produced by bombarding a boron target by a 500 kv. deuteron beam 3 mm. in diameter, through a 'half-tone' emulsion 100 μ thick and in a direction parallel to the surface. Some of the neutrons make close collisions with the protons provided by the combined hydrogen in the emulsion and project them forward at various angles with the direction of the original neutron stream. We require to determine the distribution in angle of these protons relative to the direction of the neutron stream.

We first determined the range and orientation of all the distinguishable tracks of range greater than 15 cm. of air, present in 50 mm.^{2} of the emulsion, which began and ended in the emulsion. 1,500 tracks were so measured, and of these, those tracks were chosen which had such a range and angle of scattering that their production could be definitely ascribed to the 8·7 eMv. neutron group. The method of deciding which energy group of the neutrons coming from the bombarded boron is responsible for a given track has already been described[2].

From these tracks only those were retained in which the inclination of the track to the plane of the emulsion, the angle of dip, β, was less than 10°. We were left with 400 tracks.



The number of tracks so chosen for which the angle of scattering lies between two given values evidently does not represent all the tracks in the measured area of the emulsion which have been scattered in this range of angles. Tracks will be neglected for two reasons:

(*a*) There is a rapidly increasing chance of failing to recognize tracks for which the angle of dip, β, is greater than 15°. The limitation $\beta = \pm 10°$ is therefore applied to avoid introducing uncontrolled errors.

(*b*) A certain fraction of the projected protons do not end in the emulsion but enter the glass of the plate or pass out of the surface of the emulsion. Such tracks cannot be definitely ascribed to a particular group of neutrons and are ignored.

We have thus defined the conditions in which a track is accepted. Of all the tracks produced by a neutron group of a certain energy and scattered within a given range of angles, a fraction F will be counted; S/F can easily be calculated, from the thickness and stopping power of the emulsion, for neutron groups of different energy. If N tracks are observed to be scattered in a given angular

range by a group of neutrons of a particular energy, then the total actual number of such tracks in the emulsion will be given, within the limits of the statistical error, by the quantity N/F. From the observed distribution of number with angle, we can therefore calculate the distribution to be expected if all tracks were measured.

The results of our measurements are shown in the accompanying figure, in which the number, N/F, of tracks in successive intervals of 5° in the angle of scattering are shown as circles, the vertical straight lines through the circles indicating the extent of the probable error. The distribution calculated on the assumption that the scattering is isotropical about the centre of mass of the colliding particles is indicated by the continuous line. It will be seen that the experimental values are consistent with this assumption. We may therefore conclude that the scattering departs very little, if at all, from pure 's' scattering at 9 eMv.

It is evidently desirable to make similar investigations at higher energies, and our experience shows that this should be possible with the present methods at energies up to at least 15 eMv.

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Nov. 5.

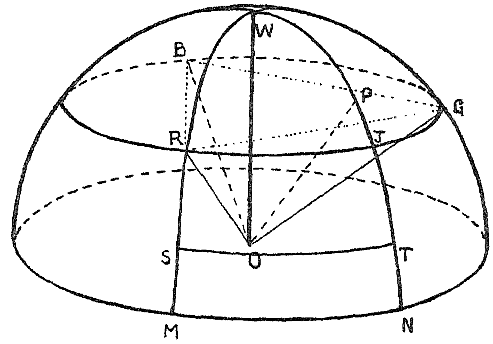
[1] Dee, P. I., and Gilbert, C. W., *Proc. Roy. Soc.*, A, **163**, 265 (1937).
[2] Powell, C. F., Nature, **145**, 155 (1940).

Colour Vision and Chromaticity Scales

In a recent issue of Nature[1], Dr. W. D. Wright has given a very clear and interesting account of recent work in the direction of commercially practical application of measurement in the matching of colours, and in their analysis or synthesis. On the practical side the first steps were taken independently by Helmholtz and Maxwell in the employment of spectrum standards—always reproducible. By means of these, other standards, more normally attainable, more readily and simply usable by scientifically untrained workers, can be brought into employment.

The problem is simplified by the plan, first used by Maxwell, of keeping the intensity constant. Only two independent variables are then present, and so a pictorial representation of results can be made in two dimensions—in particular, on a plane. Dr. Wright discusses two such representations specially. As he points out, the great trouble in all these is that of getting a scale uniform in all stages of colour variation. Approximation to that state is all that can be attained.

My object here is to inquire if a different mode of procedure, first indicated by Helmholtz, might not be worthy of consideration. It consists in the use of the sensation space instead of the stimulus space. The accompanying diagram represents the construction, which employs a hemisphere with centre O. OW is a vertical radius, perpendicular to the circular base surrounding O. The distant viewpoint is in a direction inclined slightly above the base. The small circle RGB is parallel to the base, and OR, OG, OB are three mutually perpendicular lines, all equally



inclined to OW, which may be taken as the usual axes of stimulus co-ordinates. The triangle RGB corresponds to the plane colour triangle of Maxwell, as used by him and Helmholtz. We can lay down on the plane of the triangle the spectrum curve in manner analogous to that used in the two diagrams dealt with by Dr. Wright.

Alternatively, we may consider Helmholtz's other representation by the sensation field. The line OW is the line of colourless (white) sensation. Any small (latitude) circle surrounding OW as polar axis is a curve of constant *whiteness* or constant *saturation*. Any longitude line is a locus of constant *hue*, more or less white. Constancy of the radius of the sphere corresponds to constancy of *intensity*, which is the third independent constituent quantity in luminous sensation. But the particular function of the radius which is used to express the intensity of a sensation has to be determined in accordance with Abney's law. This, and the fact that Fechner's law holds as a good first approximation, compel, as Pauli first pointed out, the adoption of the square roots of the stimuli as the component quantities to be measured along the axes OR, OG, OB. Thus the spectrum sensation curve can be drawn on the surface of the sphere.

The simplest law that we could postulate for the dependence of saturation changes and hue changes, in proceeding from one point to another on the sphere, is that of direct proportionality to the latitude and longitude changes involved. Thus increase of saturation would be taken to be proportional to increase of polar distance from W; and increase of a hue constituent would be proportional to increase of angular distance measured round OW. But the change of hue must also be proportional to the polar distance from W; for, when this is vanishingly small, rotation round W gives vanishingly small change from W, that is, vanishingly small change of hue. Thus the simplest expression for change of hue would be that of joint proportionality to longitude difference and latitude difference.

These are actually the laws, as Schroedinger first showed. A short deduction, by quaternionic treatment, has been given in Nature[2]. The first of the three terms in the last equation given on that page vanishes by the condition of constancy of intensity assumed here. (Towards the foot of the last column there, the first term on the right-hand side of the equation for Q' should read $2\,S \log q$.)

Let OP be the colour vector the difference of which from OR (standard red) is to be expressed. It is proportional to the great circle arc MN. So if we lay off SM or TN equal to PJ, the difference of hue sensation is proportional to the area of the spherical

rectangle $MNTS$. With latitude and longitude arcs drawn sufficiently closely on the sphere to form a suitable scale, this gives a very easy estimate of the difference of hue; similarly, in the case of any two colour vectors OP, OP'.

The outstanding difficulty, referred to by Dr. Wright, of getting a uniform chromaticity scale, remains. But it seems to me that the fact of the angular spread of the spectrum curve of sensation, amounting to 240° in the sensation space, as compared with 90°, or a little more, in the stimulus plane space, may indicate a considerable advantage.

In all adjustments taking place in the work of colour matching, it is equalization of sensation (hue or saturation) that is the direct aim. So this method of representation is very direct. Whether it be really superior to the representation used hitherto or not, I cannot judge, from want of familiarity with the practical needs. It would be of value to have Dr. Wright's view on the whole matter.

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[1] NATURE, **146**, 155 (1940).
[2] NATURE, **124**, 791 (1929).

IT would, as Prof. Peddie suggests, be possible to approach the problem of a uniform chromaticity scale from the point of view of the sensation rather than the stimulus. An investigation[1] somewhat along these lines is in fact in progress in connexion with the spacing of the colours on the Munsell system. But for ordinary colorimetric purposes, it is desirable that the distribution of colours should possess the geometrical relations characteristic of the trichromatic colour triangle, and to ensure that, the stimulus approach appears to be essential.

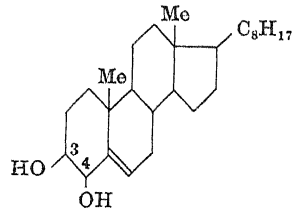
Further, I fear that the laws relating stimulus and sensation are so open to question, that a colour solid based on them would be unlikely to stand the strain of practical usage; instead, the solid would have to be derived from fresh experimental observations of colour differences, as in the case of the Munsell system. It might happen that identical colour distributions would be obtained whether the stimulus or the sensation approach were employed, but I can see no theoretical reason why this should occur, nor, so far as I know, is there any experimental evidence suggesting such a fortunate contingency.

W. D. WRIGHT.

[1] Newhall, S. M., *Amer. J. Psych.*, **52**, 394 (1939).

Formation of Insoluble Digitonides of Cholesterol Derivatives

IN the course of an investigation of 6-chloro-3-benzoyloxy-Δ^4-cholestene[1], we have isolated a monobenzoate (m.p. 153–154°) of *cis*-3 : 4-dihydroxy-Δ^5-cholestene (I) which differs considerably from the monobenzoate (m.p. 209–210°) of the *cis*-diol prepared by the method of Rosenheim and Starling[2]; the latter has been accorded the 3-monobenzoate structure on the seemingly substantial evidence that the *cis*-diol (I) gives an insoluble digitonide, whereas the monobenzoate, m.p. 209–210°, fails to do so. To test the implication that the new ester, m.p. 153–154°, is the 4-monobenzoate, its reaction with digitonin was examined. It fails to give a digitonide using standardized conditions which effect immediate precipitation of the digitonides of cholesterol and the *cis*-diol (I). It follows that the formation of one of the monobenzoates of the *cis*-diol has been accom-



(I)

panied by the migration of a benzoyl-group from the C_3- to the C_4-hydroxyl, and although such migration appears to be less likely in the case of the monobenzoate m.p. 209–210°, the exact location of the esterified hydroxyl group in the mono-esters[3] remains to be rigidly established. Furthermore, it is clear that the introduction of a C_4-*cis*-benzoyloxy-group into cholesterol prohibits the digitonin reaction.

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G. SWAIN.

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Manchester.
Nov. 1.

[1] Spring, F. S., and Swain, G., *J. Chem. Soc.*, 1356 (1939).
[2] *J. Chem. Soc.*, 377 (1937).
[3] (Added in proof). Dr. O. Rosenheim informs us (private communication) that he has prepared the hitherto unknown 4(?)-monoacetate of the *cis*-diol which, as we find is the case with the 3(?)-monoacetate, fails to give an insoluble digitonide.

A Non-Historical Eclipse

IN John Evelyn's "Diary", under the date October 14, 1688, there is a record of an eclipse of the sun. Now it is quite true that an eclipse took place, but this was not visible in any part of Europe. The central line passed very far south, and even the limit of the partial phase came only a few degrees north of the equator near its farthest extension to the north and west.

The reference to the eclipse consists of a sentence of only six words, which has much of the appearance of being a subsequent insertion. That is probably what it is, as the diarist can only be stating what some other person told him, and thus there is reason for concluding that some traveller from rather distant regions supplied the information at a later date. It is difficult to think of an answer to the problem of who the observer can have been.

The rest of the entry in the Diary states that the day was a Sunday, and prayers were offered in the churches for protection from invasion. This naturally attracts attention, but the reference is merely to Prince William of Orange, for whose arrival many Englishmen "were passionately longing".

These are Evelyn's own words, and the use of the past tense is further evidence of the fact that he was making insertions at a later date. On the third Sunday after that, the Prince, favoured by a "protestant wind", sailed into a British seaport; and he found the men of Devon willing to give him plentiful assistance in landing.

C. J. WESTLAND.

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Sept. 1.

RESEARCH ITEMS

Early Chinese Lacquer Toilet-Boxes

Two pieces of outstanding importance from the last of the Eumorfopoulos collection have been presented to the British Museum; one, a Chinese lacquer toilet-box, purchased by the National Art-Collections Fund, and the second, the blue splashed T'ang pottery horse which was the late owner's special favourite, presented by Mrs. G. Eumorfopoulos in memory of her husband (*Brit. Mus. Quarterly*, 14, 3; 1940). In a description of the two pieces by B. Gray, the lacquer box is stated to be much the most important piece of Early Chinese lacquer to have left the East. It is remarkable for its fine state of preservation and for unique features of its decoration. Judging from finds made by Japanese archaeologists in Korea, painted lacquer was the most usual material for articles of luxury in the Han period, after Chinese taste had changed about 600 B.C. from an interest in plastic form to a preference for enrichment of surfaces. In the 'Hwai-style period' inlay was extensively used to enrich the bronzes; but in the Han period a freer technique of painting came into fashion. Though also tomb furnishings, the lacquer boxes, tables and utensils must certainly have been used by the owners before death. In the tombs of Lo-lang of South Korea, of the considerable number of lacquer objects found, the most important are the toilet-boxes. These are of three main shapes, small oblong, high rectangular with coffered lids, and circular boxes with domed lids. Although several are inscribed as having been made in Szechwan, until lately no piece was known to have been found on Chinese soil. The present example, however, is said to have been found in a tomb at Haichow in the northern part of Kiangsu near the old bed of the Yellow River. It resembles generally the round toilet-boxes found at Lo-lang, but has important differences, and it differs in the style of the painted decoration. In consequence it has been assigned to the third century B.C. This is before the period to which the Korean boxes all appear to belong in the first century A.D. Probably the true date is somewhere between the two.

Parasites of the Oriental Fruit Moth

Circular 561 (June 1940) of the United States Department of Agriculture is devoted to an account of the importation, rearing and colonization of various parasites of the oriental fruit moth (*Grapholitha molesta*). The authors, H. W. Allen, J. K. Holloway and G. J. Haeussler are officers of the U.S. Bureau of Entomology and Plant Quarantine. Since about 1923, when this moth became a formidable pest in the eastern States, a good deal of consideration has been given to its control by means of parasites. The reason for this emphasis has been the absence of generally accepted artificial means of control and the great reduction in the insect's destructiveness in some areas where heavy parasitization by indigenous parasites prevails. Much of the parasite work is centred in a special laboratory at Moorestown, N.J., where extensive rearing of imported parasites has been carried out. Of these latter, seven are European species, two Australian and seventeen from China and Japan. One of the most important phases of the work has been the multiplication of the indigenous parasite *Macrocentrus ancylivorous* and its colonization throughout the area infested by the moth. The breeding for colonization of six of the principal imported species was also a major aspect of the work. It is noteworthy that no satisfactory results have been obtained by the propagation and liberation of the indigenous egg-parasite, *Trichogramma minututum*. It has not yet been possible to make recovery tests from a large proportion of the parasites liberated in different areas affected by the moth. From such recoveries that have so far been made the indications are promising, and several species have multiplied rapidly immediately following their release.

Heterosis

I. N. Sveschnikova (*J. Hered.*, **31**, 349–360; 1940) has analysed the chromosome constitution, vigour and other characters in hybrids between species and varieties of Vicia. It is believed that there is a relation between the length of the chromosomes A, F and E and the growth of definite quantitative characters. This relationship can be explained by the existence of additional genes due to duplication of parts of the chromosomes. There is a gradual change in the homologous chromosomes in the closely related species *V. amphicarpa*, *sativa*, and *angustifolia*. Thus the A and F chromosomes progressively increase in length from *N. amphicarpa* to *V. angustifolia doliochosomica*, while basal branching of 2–3 branches in *amphicarpa* increases to 20 in the last variety, and the bending-back of the standard and wings similarly increases in degree in the species. Hybrids between a race of *V. angustifolia brachisomica* and *V. a. doliochosomica* show 150 per cent increase in height over the parents. On the other hand a different race of *V. a. brachisomica* in a similar cross gave dwarf, stunted plants. Other species-crosses support the view that genes for growth are combined in the species hybrids and that plus-heterosis or minus-heterosis (depressed vigour) may be produced. Sveschnikova also notes that dominance as well as heterosis is more pronounced in species with the longer chromosomes. Segregation in second generation hybrids gives results expected on this hypothesis.

Earthquakes during October

During October last, five distant earthquakes were registered at Kew Observatory. The first, on October 1, had an amplitude of 25 μ at Kew, and the second, on October 4, probably the largest in the month, gave a ground amplitude of 110 μ at Kew, being estimated at an epicentral distance of 10,260 km. The third, on October 11, probably 12,300 km. distant, gave a ground amplitude of 78 μ at Kew, whilst the fourth, on October 22, may have originated 2,040 km. away. On October 27, an earthquake, probably at an epicentral distance of 8,720 km. from Kew, commenced registration with a compressional wave at 5h. 47m. 39s. at Kew, and at its maximum attained an amplitude of 39 μ there. This latter record, however, was disturbed by irregular long-period waves which had been noticeable through-

out the day. A further earthquake was recorded by the Bombay Observatory on October 5 and was thought to have had its origin in Tibet. Early on October 11, the region around Los Angeles and Hollywood was shaken by a tremor felt for 10 seconds, though no damage was reported. The Rumanian earthquake of October 22 has been reported previously. Late on the night of October 26 an earthquake rocked the Republic of Costa Rica in Central America, causing some apprehension, though again no damage has been reported.

Earthquakes Registered in Switzerland

During July 1940, nineteen earthquakes were registered at the Swiss observatories of Basle, Chur, Neuchâtel and Zurich. The shock of July 1 was in the Azores and that of July 6 in the West Indies. The deep-focus shock of July 10 (*ca.* 550 km.) was in the region of Tibet, and that of July 14 in the Aleutian Islands. The earthquakes of July 26, 27 and 31 were respectively in the Jura, Central America and Anatolia. During August, sixteen earthquakes were recorded. On August 4 the epicentre was near Simplon and on August 6 in the Swabian Alps near by. The shocks of August 16 and 22 were in Asia Minor and the Aleutian Archipelago respectively, all the epicentres being determined at Zurich.

Seismological Observations at St. Louis

Between June 5 and August 1, 1940, twenty-three earthquakes were registered on seismographs throughout the United States of America belonging to the Jesuit Seismological Association. At the central station at St. Louis, J. B. Macelwane, *S.J.*, and his colleagues evaluated the initial time, epicentre and depth of focus of the twelve most intense of these from all the records available to them. Besides their own, these included records from stations belonging to the United States Coast and Geodetic Survey and private observatories. The shock of June 5, on a basis of twenty-one records, had its epicentre in north-west Canada, and that of June 17 originated in the Pacific Ocean north-east of Hawaii. The second shock of June 23 originated in the Gulf of California. On July 6 there was an earthquake near the Windward Islands, while the shocks of July 10, 13 and 14 were centred in Manchuria, near Panama, and in the Aleutian Islands respectively. The earthquakes of July 19, 20, 27 and 30 had epicentres in the Aleutian Islands, near Samoa, near Guatemala, and in Anatolia respectively, and the shock of August 1 had its epicentre in the Sea of Japan between the Japanese islands and the mainland. The deepest focus shock was that of July 10, near 550 km., and other deeper than normal shocks were on July 6 (160 km.), July 14 (80 km.), and July 27 (100 km.). All the determinations are said to be tentative.

Ionization of the Lower Atmosphere

In the *Proceedings of the Royal Irish Academy* (**46**, Section A, No. 7; 1940) J. J. Nolan adds another paper to his many contributions to the study of the ionization of the lower atmosphere. It is pointed out that concentrations of small ions in the atmosphere of the order of 2,000–2,500 per c.c., obtained from the equation for equilibrium of ionization in a pure gas, that is, $dn/dt = q - \alpha n^2$ where n is the concentration of small ions of one sign (positive and negative being assumed to be equal), q is the rate of production of ion pairs per c.c. and α is the coefficient of recombination between positive and negative small ions, are very rarely met with in the atmosphere, while in cities n can fall below 100 owing to the attachment of ions to Aitken nuclei. The author goes further into the subject, discussing relevant observations, made in various parts of the world, including Australia and Java, and suggests that the equilibrium of small ions at any place in the lower atmosphere is represented by the equation $q = an + bnZ$, where n and Z are the concentrations of ions and nuclei, a being apparently constant under normal conditions, while b depends upon the nature of the nuclei present.

Solubility of Lead Salts

The solubility of lead sulphate in ammonium acetate solution is a well-known reaction in analytical chemistry. It has been attributed to the formation of undissociated lead acetate (Noyes and Whitcomb, *J. Amer. Chem. Soc.*, **27**, 747; 1905) and to the formation of an acetoplumbite complex ion (White, *Amer. Chem. J.*, **31**, 4; 1904). Sanved (*J. Chem. Soc.*, 2967; 1927), from the increased solubility of lead acetate and other lead salts in alkali acetate solution, concluded that the ion formed is probably $Pb(C_2H_3O_2)^+$, a result of the primary dissociation of lead acetate; but the experimental results were obtained with high and varying salt concentration, where the application of the law of mass action could only be qualitative. S. M. Edmonds and N. Birnbaum (*J. Amer. Chem. Soc.*, **62**, 2367; 1940) have determined the solubility of lead iodate at constant ionic strength in presence of varying acetate ion concentrations. The results are interpreted in terms of a complex ion $Pb(C_2H_3O_2)_n{}^{+2-n}$ and the slope of the curve shows that $n = 1$. Hence the complex ion is $Pb(C_2H_3O_2)^+$ and it may be inferred that the same product is formed from lead sulphate. Of the two alternative explanations, the formation of a complex ion seems, therefore, more probable than the production of undissociated lead acetate.

Trimethylcarbinol as a Cryoscopic Solvent

As a cryoscopic medium of moderate solvent power and having a melting point not far removed from room temperature trimethylcarbinol seemed to have the desired properties. The cryoscopic constants of this substance are, however, very discrepant. In a new investigation by F. H. Getman (*J. Amer. Chem. Soc.*, **62**, 2179; 1940) it is shown that by a suitable experimental procedure a sample of trimethylcarbinol having a steady melting point can be obtained; the freshly distilled solvent is removed to a room at a temperature considerably lower than its freezing point 25·1°, thus preserving it in the solid state except when required for use. The melting point then altered only slightly with time. A series of thirty solutes was used and the freezing point concentration curves were drawn. The slope of each curve at the origin gave the cryoscopic constant K. Apart from cases where interaction between solvent and solute occurred the mean value of K was 8·37, whereas the value calculated from one of the discrepant heats of fusion (21·88 cal./gm.) is 8·15. The use of trimethylcarbinol is thus shown to be entirely satisfactory as a cryoscopic solvent, provided due care is used in its preparation and preservation, and it is particularly useful when a melting point not far removed from room temperature is desired.

FERTILITY IN FLEMISH AND SMALLER TYPES OF RABBIT

By W. King Wilson,

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THE Flemish Giant is the largest breed of rabbit, and at first sight it would appear to be the most important breed for meat production. In practice, however, there is a relative scarcity of breeders who persevere with studs of typical Flemish. (It is essential to distinguish between typical Flemish, as described in the standard, and the many crosses which are often loosely described as 'Flemish'. The reasons appear later.) The standard for the Flemish Giant[1] specifies a large animal of steel-grey colour with white belly fur. No other colour is recognized in Great Britain; but in other countries a wider range is admitted. For show purposes the standard weights of adults are: bucks 11 lb. or more, and does 12 lb. or more; in 'intermediate classes' they must be less than the above weights. Whilst allowing for difficulties in securing great size and weight, together with all the other points required in show stock, the fact that there are not more breeders of a rabbit of this size suggests that there must be some underlying drawbacks.

Flemish Giants represent remarkable development and size improvement over the wild ancestor, amounting to some 300–500 per cent increase in weight over the original stock. It has been pointed out that the higher the level of production the greater the strain in maintaining that level[2], and finer adjustments are needed at the higher plane of nutrition. Furthermore, large breeds tend to have more young to the litter than small breeds[3,4]. Great size and weight though heritable are unfortunately not due to a single dominant factor, but are due to multiple factors[5,6,7,8]. This large size is of national importance for meat production in war-time. The fur colour of Steel Flemish[9] was not found to be so difficult to produce as earlier investigators had indicated from work with other varieties of steel rabbits[10,11,12,13,14]. The pelt is practically as large as that of the silver fox animal.

One of the difficulties of producing typical Flemish Giants is that they often tend to be slothful and difficult to mate when kept on the usual mixed ration. Close inbreeding for five generations was reported to have resulted in complete sterility[6]; but similar results also occurred with an inbred small breed. Hammond has published the histories of sterile Flemish bucks and does and has fully described their histological condition[15]. Some individuals are particularly troublesome, but may sometimes be assisted by appropriate handling. This disinclination to copulate, and the number of infertile matings, is very marked by comparison with the smaller and intermediate breeds. Both the latter are much more popular with breeders.

During last winter the severe frosts prevented the use of green foods for approximately two months (January and February) and roots were generally too frosty for use. Over a period of eight weeks the stock received an average of only one feed of roots or beet pulp weekly. It should therefore be interesting to compare the fertility of Flemish and smaller breeds during this and the immediately ensuing breeding season.

Experimental

The stock was divided into three main groups comprising (*a*) Flemish and first cross Flemish does; (*b*) brown Beveren type does; and (*c*) Dutch does. There were thirty-two to thirty-four matings, or attempted matings—by putting the doe to the buck—in each group. Fertility of does in the different breeds is shown below:

TABLE 1. FERTILITY OF FLEMISH AND SMALLER TYPES.

Breed	Flemish	Flemish first cross	Combined	Beveren type	Dutch	Total
No. matings attempted	21	13	34	34	32	100
No. litters	9	12	21	31	28	80
Per cent fertile	42·86	92·31	61·76	91·18	87·50	80·00

The fertility was good in Beverens (91 per cent) and Dutch (88 per cent), the latter's average being reduced by one doe which required 3 matings to become fertile. The well-bred typical Flemish stock gave a very poor level of fertility (43 per cent); but in striking contrast to this the first cross Flemish does were practically always fertile, with 12 litters from 13 matings, or 92 per cent. The F_1 does consisted of seven matings from large × large type (Flemish × Belgian) does, which produced six litters; and six matings of large × small type (Flemish × Tan) does which produced six litters. Thus it appears that the type to which the Flemish is crossed is immaterial, and regardless of the size of breed used for the outcross the F_1 show remarkable improvement in fertility over typical Flemish stock.

The average litter size from these different groups did not provide any large differences in the number of young:

TABLE 2. LITTER SIZE FROM FLEMISH AND SMALLER TYPES.

Group	Flemish	Flemish first cross	Combined	Beveren type	Dutch
No. of litters ..	9	12	21	31	28
Average number of young ..	5·22	5·08	5·14	5·19	5·43
Range	2–11	1–8	1–11	2–8	1–9

The litter size for Flemish was lower than usual, although the largest litter (eleven) was produced by this breed. The average for F_1 does was also lower than expected; the Flemish × Belgian was only 4·50, whilst the Flemish × Tan was 5·67 per litter. The Flemish had the greatest range of litter size, and the Beveren had the narrowest, as shown in

Table 3. The Dutch maintained a good average, for their size, at 5·43 per litter, which is explained by nineteen of these litters being from outcrosses averaging 5·58, whilst the average from Dutch × Dutch matings was 5·11. The range for Dutch × Dutch litters was 4–7 but was more than doubled when outcrossed, ranging from 1–9 young, which, surprisingly, is greater than from the larger type does from the Flemish outcrosses.

TABLE 3. DISTRIBUTION OF LITTER SIZE BY BREED.

Litter size	Flemish	Flemish first cross	Combined	Beveren type	Dutch	Total
1	–	1	1	–	1	2
2	1	2	3	2	1	6
3	2	1	3	3	–	6
4	–	–	–	5	7	12
5	4	2	6	5	5	16
6	–	2	2	6	6	14
7	–	1	1	8	5	14
8	1	3	4	2	2	8
9	–	–	–	–	1	1
10	–	–	–	–	–	–
11	1	–	1	–	–	1
Total	9	12	21	31	28	80

A guide to the weight of different groups of does is taken from their live weights during lactation at approximately the time when the young began to leave the nest: Flemish, 9 lb. 6 oz.; Flemish and first cross, 8 lb. 13·13 oz. (Flemish × Belgian, 8 lb. 11·67 oz., and Flemish × Tan, 7 lb. 3·00 oz.); Beveren, 7 lb. 0·47 oz.; Dutch, 4 lb. 14·00 oz. It will be seen that popular varieties of fur and fancy breeds bred more freely than giants. Furthermore, after weaning, the small types were ready for further breeding sooner, and more readily, than large heavy animals.

Conclusion

The Flemish Giant is the largest breed of rabbit, but it is slothful and more difficult to breed than either the medium-sized fur breeds or the small fancy breeds (for example, Beverens and Dutch), when fed and managed under similar conditions.

First crosses from Flemish were fertile, irrespective of whether the cross was to large or to small breeds.

After an abnormally severe winter, which resulted in changes of diet, the average litter size of larger types was lower than expected and nearer the level for small breeds.

[1] Standard. Flemish Giant Rabbit Club, London.

[2] Wilson, W. King, and McCartney, W., "Rabbit Feeding for Meat and Fur", Imperial Bureau of Animal Nutrition, Aberdeen, Technical Communication No. 12 (1940).

[3] Pickard, J. N., "A Preliminary Study of Some of the Factors Influencing the Duration of Pregnancy and Litter Size in the Rabbit," IVth World's Poultry Congr. Papers, Section F, 901 (1931).

[4] Rosahn, P. D., Greene, H. S. N., and Hu, C. K., *Proc. Soc. Exp. Biol. and Med.*, **31**, 1214 (1934).

[5] Punnett, R. C., and Bailey, P. G., *J. Genet.*, **8**, 1 (1918).

[6] Pease, M. S., *J. Genet.*, **20**, 261 (1928).

[7] Castle, W. E., "Size Inheritance in Rabbit Crosses", Carnegie Inst., Washington, Pub. No. 320, 3 (1922).

[8] Wilson, W. King, *J. Heredity*, **27**, 127 (1936).

[9] Wilson, W. King, "Alternative Modes of Inheritance of Steel Grey Coat Colour in Rabbits", VIIth Internat. Genet. Congr., Section D, 1939.

[10] Punnett, R. C., *J. Genet.*, **2**, 221 (1912).

[11] Punnett, R. C., *J. Genet.*, **5**, 37 (1915).

[12] Punnett, R. C., *J. Genet.*, **23**, 265 (1930).

[13] Pap, E., *Z. Induktiv. Abstammungs- und Vererbungs-lehre*, **26**, 185 (see 14) (1921).

[14] Onslow, H., *J. Genet.*, **12**, 91 (1922).

[15] Hammond, J., "Reproduction in the Rabbit" (Edinburgh: Oliver and Boyd, 1925).

BICENTENARY OF HENRY CORT

Of the leading contributors to the advancement of British industries in the latter half of the eighteenth century, Henry Cort is the one of whom we know least. It is generally stated that he was born near Lancaster in 1740, and to mark his bicentenary, at a meeting of the Newcomen Society on November 13, Dr. H. W. Dickinson read a paper giving much new information about the inventor and his activities. Though nothing is known of Cort's education and early life, by 1765 he had established himself in London as a Navy agent, having an address in Crutched Friars in the east of the City, in which also was a Navy pay office. The district was one familiar to Pepys and has many associations with the Navy of bygone days. A Navy agent was a banker and attorney who acted for H.M. ships as to pay, allowances, prize money, salvage and such like; and it was Cort's connexion with the Navy which ultimately led to his becoming an iron master.

From 1765 Cort slowly emerges from the obscurity of his early life. In 1768 he married a niece of a Mr. Attwick who had contracted to supply mooring chains and other iron naval stores to Portsmouth Dockyard, but who in 1772 assigned his contract to a Mr. Morgan, who had a forge at Fontley, in the parish of Titchfield, two miles from Fareham at the north-west corner of Portsmouth Harbour. Britain at this time was largely dependent on Sweden for its wrought iron, and Morgan's work consisted more in remaking old wrought iron into new articles than in the production of the iron itself. From the beginning of the eighteenth century a forge had been in existence at Fontley, where there was a tilt hammer worked by water-power and an adequate supply of charcoal. Morgan being in financial difficulties, Cort came to his assistance, and in 1775 took over the management of the concern. Under Cort, the works were improved and the profits considerable. In spite of this there was further need for capital, and Cort accordingly secured the help of Adam Jellicoe who, while pay clerk at Portsmouth, had acted as his agent.

By 1781–83 the works were engaged on the conversion of considerable quantities of old iron mast-hoops into new hoops, and it was then that Cort made a variety of experiments and took out the first of his two memorable patents. The date of this patent, No. 1351, was January 17, 1783. It was for "A New Mode and Art of Shingling, Welding and Manufacturing Iron and Steel into Bars, Plates, Rods and otherwise, of Pure Quality, in large Quantities by a more effectual Application of Fire and Machinery, and with greater Yield, than any Method before attained or put in practice." "In the specification Cort further described passing the heated iron through

the rollers of a common rolling mill and the making of bars, bolts, half flats, etc., by the use of rollers with grooves and collars."

Thirteen months later Cort secured his other patent, No. 1420, of February 13, 1784, for "A Peculiar Method and Process of Preparing, Welding, and Working various Sorts of Iron, and of reducing the Same into Uses by Machinery," in which he described the process afterwards known as "dry puddling", a process which, using coal instead of charcoal, was destined to be of immense importance to the iron industry. In examining Cort's practices and patents, Dr. Dickinson came to the conclusion that there could be no doubt that the patents are simply a recapitulation of the technique Cort was carrying out at Fontley. Cort, of course, was not alone in his endeavours to improve the production and working of iron, but after reviewing the efforts of his contemporaries Dr. Dickinson concluded that "what we can say of Cort was that he gathered existing knowledge and technique, absorbing what was useful and necessary for his purpose, rejecting what was not needed, and combining it into a system which, as a whole, constituted such an advance that it marked an entirely new era in the manufacture of wrought iron. The effect of his labours was immediate; whereas a tilt hammer had been able to produce a ton of bars in 12 hours, no less than 15 tons could be passed through the rolls in the same time; the iron, produced as it was entirely by pit coal, was of a quality that enabled it to compete for all but the most exacting requirements with the charcoal iron of Sweden, Russia and New England. The process enabled Great Britain, relying on mineral fuel, to advance within a decade to the premier iron-producing country of the world."

Contracts from the Navy Board continued to come to Cort and Jellicoe, and Cort travelled to many places to assist iron makers to instal his rolls and puddling furnaces. If all had gone right he should have gained a fortune comparable to that later enjoyed by Bessemer. It has been the lot of many inventors to see the financial rewards due to them slip through their fingers, but none of them, perhaps, was treated more unkindly by fate than Cort. Five years after his patent of 1784, which afterwards led to the construction of puddling furnaces by the thousand, Adam Jellicoe died and his papers showed that he was in default to the Navy for no less than £39,676. There being then no limited liability, the works were seized, no effort was made to exploit the patents, and Cort was reduced to bankruptcy. With a numerous family Cort was left to struggle along as best he could, save that in 1791 he was granted a Government pension of £200 a year, which with reductions for fees amounted to little more than £160. Nine years later, on May 23, 1800, he died and was buried in Hampstead Churchyard, his death passing with no notice save a couple of lines in the *Gentleman's Magazine*.

Such is briefly the outline of the story Dr. Dickinson had to tell. Many famous men were interested in Cort's work, including Black, James Hutton and Watt, and the latter wrote of Cort as he knew him at the age of forty-four that "he seems a simple good-natured man, but not very knowing." Though neglected in his day, Cort has not wanted for admirers in our own times, and it was through an American ironmaster, Charles H. Morgan (1831–1911), that Cort's tombstone in Hampstead Churchyard was renovated and a bronze tablet placed in the porch of the church saying that to Cort "the world is indebted for the arts of refining iron by puddling with mineral coal and of rolling metals in grooved rolls". Introduced in a period when the steam engine was making rapid strides, when men were experimenting with iron boats, steam-boats, locomotives, and iron railroads, and when iron was being widely used as a material for construction, Cort's improvements enabled our ironmasters to meet all the rapidly growing needs of the pioneers of the modern engineering world, and his methods were not superseded until the labours of Bessemer, Siemens, Martin and others ushered in the age of steel.

SOIL BACTERIA AND WAR WOUNDS

By Dr. Hugh Nicol

A SURGICAL development which evolved on a large scale in the recent Spanish Civil War is the treatment of dirty and often comminuted and complicated fractures by immobilization in a plaster cast. The cast is applied immediately after the wound has been made 'mechanically' clean by removal of bone and metal splinters and fragments of clothing and other foreign matter and by resection of all dead tissue that can be found; no antiseptic is applied to the wound itself. Subject to this preliminary cleansing and to the provision of traction and drainage as necessary, no other treatment is given during the month or so during which the first cast is in position; the plaster is then changed, and the second cast is allowed to remain for some weeks, after which union and healing are usually remarkably complete.

The success of the treatment depends on ignoring the bacterial processes such as surgeons normally take great pains to combat by the use of antiseptics, irrigation, and frequent changes of dressings: it has been found that, given the initial surgical *débridemen* and cleansing, and complete immobilization, no general infection occurs. There is locally great microbiological activity, as is evidenced by the stench given off during the first three weeks (this is apparently the only objectionable feature of the treatment), but undesirable complications of bacterial origin—such as gas gangrene—are rare. The treatment is largely empirical; its justification is that it has worked. A history of the treatment and an analysis of its application to a large number of cases have been given by J. Trueta[1], sometime director of the Department of Surgery in the General Hospital of Catalunya, Barcelona.

It could scarcely be expected that in the stress of civil war the microbiological changes could be examined in detail. It has been shown (*loc. cit.*) that the organisms in a plaster-treated wound are mainly aerobic, but no particular species or group of aerobes predominated, except that there was a tendency for

B. pyocyaneus to become more numerous when the healing process was well established.

However obscure the theory of the treatment is, the references to soil bacteriology made in connexion with it require attention. Trueta records (p. 17): "The incidence of gas gangrene and of other infections fell so markedly [after a thoroughgoing adoption of the treatment] that it has been suggested that the soil of Spain contains no anaerobes. These suggestions emanate from foreign surgeons who came to Catalonia in the later stages of the war: at the beginning it was demonstrated grimly enough that the soil of Spain is not free from these organisms." This notion is not confined to Spanish territory. The commandant of an English ambulance who is known to me attended in London a course of lectures given by a British medical man, who averred that the treatment could not be expected to be successful in all countries: in Spain, where such sub-tropical crops as grapes and oranges grow in the open air, the soil micro-organisms were necessarily different from those occurring in more temperate climates.

Though no determination of Spanish soil microflora is at hand, there is no evidence that the broad types of soil micro-organisms vary with climate. A high degree of constancy of species has been demonstrated for soil Protozoa in samples taken in the most diverse parts of the world[2], while to mention only three sets of determinations of species of soil bacteria, the work of Chr. Barthel[3] on Greenland soils, and various papers by M. Adachi [Adati] on Formosan microflora, have revealed scarcely any but familiar species; a similar remark applies to the bacteriological findings from the second Byrd Expedition to the Antarctic. Barthel also showed that the dung of polar mammals contained bacteria similar to those occurring in the dung of common animals of temperate regions.

The main groups of soil bacteria are probably ubiquitous, and the medical men concerned should call upon their soil scientist colleagues before erecting theories about the distribution of soil microorganisms. One is left with an uneasy feeling that the fact of the existence of anaerobes in Spanish soil has been established by the clumsy method of observation of human patients. The point is not important, but co-operation between soil bacteriologists and the medical profession would have obviated a mis-statement.

The success of the treatment seems to repose less upon the distribution of bacterial species than upon a factor or set of factors to which the medical profession in its preoccupation with pathogenicity of bacteria has given little attention: namely, the powers of resistance of living tissue towards microbial invasion. R. Giani[4] showed that inoculation with anthrax bacilli of open wounds of experimental animals was harmless if the affected limb was immobilized. This is significant, and if the true implications of the plaster-cast treatment of war wounds are followed up, the present importance of using antiseptics and of other treatments aimed at annihilating bacteria will almost certainly give way to a recognition of the importance of constructive methods of building up bodily resistance to adventitious infections.

1 Trueta, J., "Treatment of War Wounds and Fractures" (London: Hamish Hamilton, 1939).

2 See Sandon, H., "The Composition and Distribution of the Protozoan Fauna of the Soil" (London and Edinburgh: Oliver and Boyd, 1927).

3 *Særtryk Medd. om Grønland*, 64 (København, 1922).

4 Giani R. *Giorn. R. Accad. Med. Torino*, 11, 165 (1905).

FORTHCOMING EVENTS

Monday, December 2

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 3).

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. J. V. Harrison: "Coastal Makran".

Tuesday, December 3

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. J. D. Bernal, F.R.S.: "The Physics of Air Raids".

Wednesday, December 4

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. D. E. E. Gibson: "Problems of Building Reconstruction".

Thursday, December 5

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 2.30 p.m.—Mr. T. P. McMurray: "The Semilunar Cartilages" (Robert Jones Memorial Lecture).

Friday, December 6

ASSOCIATION OF APPLIED BIOLOGISTS (in the Congregational Hall, Victoria Road, Harpenden), at 12 noon.—Sir E. John Russell, F.R.S.: "The Function of Applied Biology in War Time".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GENERAL SECRETARY—The Hon. Secretary, International Federation of University Women, 38 St. Leonard's Terrace, London, S.W.3 (December 4).

HEADMASTER OF THE MAIDENHEAD COUNTY BOYS' SCHOOL—The Education Secretary and Secretary to the Governors, Shire Hall, Reading (December 5).

KEEPER OF THE YORKSHIRE MUSEUM—The Honorary Secretary, Yorkshire Philosophical Society, The Yorkshire Museum, York (December 7).

TEACHER TO TAKE CHARGE OF ELECTRICAL ENGINEERING—The Principal, Technical College, Wolverton, Bucks (December 9).

ASSISTANT OFFICER (CIVIL ENGINEER) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (quoting Appointment 1/10A) (December 14).

MASTER OF METHOD AND LECTURER IN GEOGRAPHY (MALE) at the Edinburgh Training Centre—The Executive Officer, 140 Princes Street, Edinburgh 2 (December 14).

WARDEN OF ASHBURNE HALL OF RESIDENCE—The Registrar, The University, Manchester 13 (December 18).

REGISTRAR OF THE UNIVERSITY OF BIRMINGHAM—The Secretary, University of Birmingham, Edmund Street, Birmingham (January 1).

PART-TIME TEACHERS IN STRENGTH OF MATERIALS, MACHINE DESIGN AND HYDRAULICS—The Principal, South-West Essex Technical College, Forest Road, Walthamstow, E.17.

MATHEMATICAL TUTOR in the Secondary School of the Gordon Memorial College, Khartoum—The Controller, Sudan Government Office, Oxford Hotel, 261 Clifton Drive South, St. Annes-on-Sea, Lancs. (quoting 'Mathematical Tutor').

ASSISTANT PHYSICIST at the Bradford Regional Radium Centre—The Medical Officer of Health, Town Hall, Bradford.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Indian Forest Records (New Series). Entomology, Vol. 6, No. 3: Possibilities of Control of Lantana (*Lantana aculeata* Linn.) by Indigenous Insect Pests. By Dr. C. F. C. Beeson and Dr. N. C. Chatterjee. Pp. iii+41–84. (Delhi: Manager of Publications.) 1·4 rupees; 2*s*. [111

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 237: On Coccids found on Roots of Plants in Egypt. By Mahmoud Hosny. Pp. iii+21+3 plates. (Cairo: Government Press.) P.T.3. [411

NATURE

Vol. 146 | SATURDAY, DECEMBER 7, 1940 | No. 3710

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Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

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Vol. 146 SATURDAY, DECEMBER 7, 1940 No. 3710

BRITISH AGRICULTURE IN WAR-TIME

IT is all too true that as civilized life develops, its problems multiply and become more difficult to solve. In primitive agriculture man had but to contend with elemental forces that opposed him when he began to grow food, instead of merely hunting for it or gathering it. In modern agriculture we have not only to adjust our environment to the needs of particular crops and animals and to conserve soil fertility, but also to concentrate production in delimited areas to help maintain large industrial populations that live off the land, if not upon it. We have also to organize transport and distribution through a medley of middlemen and vested interests without causing the cauldron of social unrest to boil over. In war-time these problems are aggravated by disorganization of labour and transport, and by the vital need of producing as much food as possible in proximity to consuming centres.

Owing to the neglect of agriculture, to the huge growth of the industrial population, and to developments in submarine and aerial warfare, Great Britain is now at pains to maintain her food supplies ; and the difficulties of to-day are greater than those experienced in 1914, because since then we have lost some $2\frac{1}{4}$ million acres of arable land and about one quarter of our agricultural workers, large areas of grassland have become derelict, death duties have deprived the land of capital and unpredictable prices have badly handicapped the progressive farmer. Our shipping, overseas investments, and exports have all declined. On the other hand, science applied to agriculture has shown how yields of many crops, including grass, can be increased, and how numerous plant and animal pests can be controlled ; farm labourers are better paid, and the output efficiency per worker has increased ; the number of agricultural tractors has increased by 44 per cent since September 1939 ; so far, there has been very little reduction in livestock numbers, and good stocks of essential foodstuffs have been stored, for man if not for beast.

The chief agricultural problem of the moment is the production of more home-grown human food, and closely related thereto are the problems of feeding-stuffs, prices, and labour. The weekly wage of the farm worker has been raised to a minimum of 48*s*., and although 70,000 workers left the land for other pursuits in the first ten months of war, this leak has now been sealed. Unremunerative prices have long been the bugbear of the farming community, and to-day price-fixing at profitable levels is vociferously demanded. Notwithstanding efforts of the legislature to make farming profitable by means of the Wheat Act of 1932, sugar-beet subsidies, and marketing boards run by producers, the outlook for farming has remained precarious, and ever mindful of his bad experience when the Corn Production Act was repealed in 1921, the farmer is naturally anxious for the future. There can be no argument that in peace-time *efficient* farming must be made remunerative ; but too great and too frequent insistence on having good prices now, when many are sacrificing far more than their worldly wealth, is apt to alienate the sympathy of the urban electorate, upon whose votes the future prosperity of farming will depend. There is, however, no question that our farmers may be relied upon to pull their weight in the present emergency ; and they will be encouraged by the recent assurance of the Minister of Agriculture that the present system of fixing prices in advance will be continued throughout the War and for one year afterwards.

The provision of fodders and feeding-stuffs for livestock is especially important, because it affects the dietary of the whole nation. Thanks to a favourable climate, we produce sufficient grass and hay for nine months' supply, but the production is seasonal and the gap is filled largely by importing 'concentrates' (cereals, cereal offals and oilcakes) to the tune of about 9 million tons a year. These concentrates occupy much shipping space and involve currency payments abroad. Munitions of war and food for direct human consumption being of prior importance, we must now seek to compensate restricted imports of concentrates by growing more fodder at home, by eliminating wasteful feeding, and by reducing flocks and herds consonant with diminished imports. Now increased production of home-grown fodder competes with food production for direct human consumption, and it is well known that feeding man through animals involves great loss of nutrients; for example, it takes 10 lb. of concentrates to provide 1 lb. of butter, and up to 20 lb. of wheat to produce 1 lb. of beef. Hence, in war-time, arable land growing human food is more important than grass or arable land growing food for stock.

One of the meritorious achievements of the Ministry of Agriculture has been the ploughing-up of more than two million acres of grassland in the first nine months of war, a good proportion of which has been used for growing oats and wheat. It is now planned to break up a further million acres of grassland, the selection of which will be much more difficult than the first two millions. No definite guidance has been given as to how newly broken land is to be cropped. The cropping must depend to some extent on the local conditions, but it seems reasonably certain that the bulk of it will be devoted to growing cereals, and increasing the acreage under potatoes, which so far have been somewhat neglected, leaving comparatively little for growing roots and other animal fodders. Some leeway may be made up by growing kale and catch crops of rape, rye, late-sown barley, etc., and, in general, higher yields can be obtained by a more liberal use of nitrogenous and phosphatic fertilizers. Various suggestions have been made for increasing supplies of home-produced feeding-stuffs, such as utilization of all slaughter-house offals, predigestion of straw with alkali, and ensiling a million tons of grass for winter feed, but Dr. Norman Wright has already shown (NATURE, Aug. 24, p. 251, and Nov. 30, p. 712) that little substantial help can be expected from these sources, or even from the adoption of minimum standards of feeding ordinary rations.

The Minister of Agriculture has recently stated that during this winter allocations of feeding-stuffs not grown on the farm will probably be reduced to 70 per cent of normal supplies for dairy cattle, to about one half for other cattle and sheep, and to one third for pigs and poultry. This ruling is in line with the policy followed in Great Britain and in Germany during the War of 1914–18, and by Germany in Denmark and Holland at the moment; it means a gradual slaughtering of livestock (except milch-cows), pigs and poultry being the first to suffer.

There is, however, something to be said for the view, shared by many, that pigs or poultry, or both, should have precedence over beef-cattle. The late Mr. Christopher Turnor, whose death is a great loss to British agriculture, recently stated that for more than ten years he had produced "excellent grass-fed beef and mutton on heavy clay pasture, properly treated, without using any imported cake or concentrates whatever". It would be encouraging to think that this practice could be, or would be, followed at all generally; nevertheless, it suggests one means of helping to maintain our best beef-cattle and sheep. It therefore looks as if the Briton's dietary will gradually shift, at least during the war years, towards lactovegetarianism; and there is little doubt that the national health would not suffer thereby. A large proportion of our adult population, in particular sedentary folk and those who neither toil nor spin, could well give up half the meat they normally eat, and thrive on a dietary supply of some 60 gm. of protein a day (instead of the usually accepted 100–120 gm.), provided, of course, that other nutritional elements, especially vitamins and minerals, were consumed in adequate amounts.

The severe troubles of British agriculture, which began when cheap wheat from North America began to flood our markets in the late eighteen seventies, have never been boldly tackled by Government, and they have been aggravated by the intractable individualism of the farmer. Lack of vision on the part of our rulers has been the keynote of most of our lack of successes. In agriculture the need has always been for a comprehensive long-term policy, and one which would be compatible with war-time as well as peace-time conditions; instead of it, we have been

treated with what Lord Bledisloe calls "hectic legislative patchwork". The outbreak of war in 1914 found us unprepared in almost every department of State, including agriculture. It was not until 1917 that the newly created Food Production Department began its successful labours ; but even this, as Sir Thomas Middleton has recently told us, was handicapped by the delay in adopting a policy. Delay and makeshift are the inevitable concomitants of lack of vision ; and the story has been repeating itself to some extent during 1939–40. Although the present War began to brew in 1933, practically the only serious preparatory step taken in the agricultural field was the creation of the Food (Defence) Department, which reported in 1938. Up to June 1939, only 150,000 acres of grassland had been broken up for arable production, and tractors were in short supply for war-time purposes. The Government had indeed subsidized the use of lime and basic slag in the interests of soil fertility, but these were home productions, and so the opportunity to increase the reserves in the soil of those nutrients which are mainly imported was missed ; and scarcely a beginning had been made with the drainage of water-logged land. The allotment movement, which reached its zenith during 1918–19, was allowed to languish, and no stimulus was given to increased production of vegetables, especially of onions and carrots, which were mostly imported. No plans were made to develop the results of research, conducted by private interests, on ensilage, the use of straw as fodder, or that of urea or ammonium bicarbonate for rectifying protein deficiency in the rations of milch cattle.

This list of omissions is not complete, and the recital of it is distressing, but it will serve to indicate the lamentable shortcomings of past agricultural administrations. The faculty of foresight or prevision is not one that is easily developed ; it is, however, a distinguishing feature in the mental equipment of the gifted scientific research worker, and it may therefore be suggested that the inclusion within the administrative body of one or two outstanding men of this type might prevent the recurrence of past ineptitudes. It may be that there is little transfer of insight and predictive ability from scientific research to politics and sociology ; experiment alone can decide, and it is worth trying. The fact that the few scientific men who have been elected to Parliament in the past have failed to leave their mark on policy is no evidence to the contrary, because it is not knowledge of science that is the essential qualification—useful though this may be—but sound judgment and ability to look ahead. Improvisation has its place in the casualty ward and on the music-hall stage, but in the sphere of political control it is weak and dangerous. In agriculture at least we must have insight, foresight, and long-term planning.

NUTRITION IN THE HOME

The Nation's Larder and the Housewife's Part Therein

A set of Lectures delivered at the Royal Institution of Great Britain in April, May and June 1940, by Prof. J. C. Drummond, Maj.-Gen. Sir Robert McCarrison, Sir John Orr, Sir Frederick Keeble, Dr. L. H. Lampitt, Prof. V. H. Mottram, Dr. J. C. Spence ; with a Supplement by Dr. Franklin Kidd. Pp. xii + 146. (London : G. Bell and Sons, Ltd., 1940.) 2*s*. 6*d*. net.

"THE Nation's Larder" offers to the inquiring housewife much food for thought, perhaps not very easy for her assimilative capacity. A preface by the President of the Royal Society and a letter from the Minister of Food stimulate an appetite for the substantial courses to follow.

It is agreed that in days long past the British peasant's larder was most satisfactorily stocked with a few simple sustaining foods, dairy produce, coarsely ground meal, potatoes, green and root vegetables. In recent years the larder was more variously but less adequately filled, and the nation's health and teeth have suffered from the consumption of *sophisticated* foodstuffs. War enforces a reversion towards a debased form of peasant's diet, debased because the bread and cereals of which it substantially consists have been deprived of essential ingredients. The majority of the British public are content with white bread, and the few who want wholemeal now have difficulty in getting it. There is an official scheme to reinforce white flour with synthetic vitamin B_1 (aneurin) and calcium, but that will not restore the protein, the iron and other minerals, and vitamins A, B_2 and E removed in milling.

There are two ways of reforming a bad diet. The best method, that advocated by Sir Robert McCarrison, is to rebuild it on the lines of the peasant diet. Another less satisfactory method is to keep the bad diet and supplement it with those foods misleadingly called *protective*. The classification of foods into three groups, energy producing, body building and protective, as adopted by Prof. Mottram on pp. 99 and 100, is with good reason adversely criticized by Dr. Spence on p. 113, in his most helpful section on the feeding of children. *Whole*some foods like dairy produce, whole seeds and vegetables are not only protective but also energy giving and body building. The artificial grouping into three classes would be meaningless had not certain refining processes, such as the roller milling of grain, the preparation of concentrated sugar and of pure fats and oils, created a new class of *unwhole*some foods which serve solely as fuel and do not feed the living tissues of the body. A grave error on p. 100, repeated again on p. 108, is the omission of that most protective group of foods, *whole* seeds and their products. These, the peasant's mainstay, are insufficiently stocked in the larders of to-day.

As a method of supplementary feeding suitable for ill-nourished mothers and school children, several of the authors commend the 'Oslo breakfast', a peasant type of meal of wholemeal bread, fruit, salad, raw carrot, milk, cheese, yeast, etc. But why go so far afield for a model while in our country there is that excellent working model the 'Glossop lunch' used successfully by Dr. Milligan, medical officer of health for Glossop, before Oslo breakfasts became famous.

Despite the merits of the peasant diet there is no justification for refusing to profit by the benefits which applied science, industry and commerce offer. Canning and chilling of foodstuffs, their transport from overseas and preparation in bulk by factories can now be achieved with less loss of nutritive value than home produce suffers in distribution and kitchen handling. The supplement by Dr. Franklin Kidd on the artificial preservation of food is of great interest.

The provision of a diet fully adequate for the health of every family will, says Sir John Orr, enable us to carry through post-War reconstruction with the minimum of strife. For the development of home food production, Sir Frederick Keeble and Sir Robert McCarrison stress the need for better attention to the land. Crop yields can be doubled in quantity and improved in nutritive value if the soil is properly fed and aerated.

Every corner of the nation's larder and its sources of supply are thus carefully scrutinized, but apart from her function as milch cow the housewife's part therein is ill-defined. In fact, it seems that as cook-housekeeper she should be superseded by the large-scale caterer, for Dr. Lampitt insists on the advantages of communal feeding "to cater for a million is to save the nation's wealth". VIOLET G. PLIMMER.

ANATOMICAL EMBRYOLOGY

A Manual of Embryology

The Development of the Human Body. By Prof. J. Ernest Frazer. Second edition. Pp. x+523. (London: Baillière, Tindall and Cox, 1940.) 30*s*.

STUDENTS of the development of the human embryo will welcome the new edition of Prof. J. E. Frazer's "Manual". The general plan and scope of the work has not been altered by the changes and additions which have been made since it first appeared. It is a book which keeps close to its subject-matter—human embryology for the medical student and anatomist. Thus Prof. Frazer eschews both histology and comparative morphology. Of the anatomical facts which come within its purview, the book gives an account which is not only comprehensive and thorough, but also in several respects original. The author in his preface points out that in several places his descriptions will be found to diverge from embryological orthodoxy, and emphasizes that these divergences are the result of his own extensive researches. The work is, in fact, an original contribution as well as a text-book, and it will therefore be doubly interesting to the advanced worker. It is, however, unfortunate that no references are given, so that the student may find it difficult to distinguish the more original and controversial parts from the more conventional; but this is a comparatively minor danger which can easily be surmounted if the book is used under the guidance of a teacher.

There are several other reasons why the book is scarcely suitable to serve a student as his fundamental text-book. The very fact that it is partly a presentation of original research has had the more or less inevitable result that the allocation of space, and the fullness of the treatment of different subjects, has been influenced by the interest they hold for the author. For example, one notices a very excellent discussion of the

derivatives of the pharynx, which is on quite a different level of completeness from the descriptions of the eye and inner ear. Moreover, there are some parts of the subject in which it is at present probably impossible to give a completely satisfactory account without more comparative material than the author allows himself. Examples are the earliest stages of development and implantation, in connexion with which a consideration of the recent work of Streeter and the Baltimore school must be considered as almost a necessity ; and the formation of the placenta is a topic for which comparative material is even more than usually illuminating.

One may doubt, indeed, whether it is possible to draw any general principles from a study of development which confines itself strictly to human material. Certainly our understanding of the basic anatomical processes at work during embryogenesis has in recent years been advanced mainly by studies on other forms. The demonstration of the reality and importance of cell streams is a case in point. For a complete account of embryology, suitable to provide the main guide to a young student, some consideration of these fundamental processes is essential.

The foregoing remarks are, however, not so much criticisms of Prof. Frazer's book as descriptions of the limits of the field with which he deals. Within those limits the book can be heartily recommended. It is an excellent, if not entirely orthodox, work of reference for the biologist who finds himself in need of embryological information, and it will be stimulating and illuminating supplementary reading for the student. C. H. WADDINGTON.

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharge in Gases

By Prof. Leonard B. Loeb. Pp. xviii+717. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 42*s*. net.

IN recent years the subject of electrical discharge in gases has entered upon a new and active phase. The burst of activity which was followed by J. J. Thomson's first classical treatise early in this century was ultimately slowed up because the presence of gas essential to the phenomena was in itself a stumbling-block, since it introduced variables not capable of independent experimental control. The focus of attention thus passed in subsequent years from self-maintained discharge to the relatively simpler phenomena in high vacua, with most valuable consequences, both theoretical and experimental. The position then reversed itself in that it was in the details of mechanism of high vacuum phenomena that our knowledge became so much more definite. The time was then ripe for a return to the more complicated problems arising from the introduction of gas at relatively high pressures; helped no doubt by industrial applications of glow discharge much new data has been accumulated during recent years and a critical treatise in the English language embodying these results and relating them to the familiar early work was much needed. Prof. Loeb's volume supplies this need, and the treatment is helped by the fact that the author himself has personally carried out or directed valuable researches on many of its aspects.

The volume opens with a description and discussion of measurements of the mobility of ions, later followed by a special chapter on electron mobility and a very full treatment of recombination. The problems of electron energy distribution, the theory of probes, ionization by collision, the part played by positive ions are all fully discussed, as of course it is necessary that they should be in leading up to the remaining third of the book on disruptive, corona, arc and glow discharges.

There will be few readers who will not find new material in this work and to most it will prove to be full of information, much of which may have passed unnoticed by them in its original form in scientific journals.

It is still true, of course, that in many of these phenomena, with which all physicists are familiar in broad outline, no finality can yet be said to have been reached. The author himself prefers to call his work a monograph rather than a textbook, and adds that in a book of this nature he figuratively lays the cards on the table, presenting the reader with facts and conflicting views and throwing "the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance".

But the reader will perhaps feel in consequence that the work is in some parts a little overloaded with controversial detail and a touch of special pleading for the acceptance of the author's results or conclusions rather than those of other workers. On the other hand, nothing is more exasperating to the non-specialist, seeking information, than the other type of handbook, not uncommon, which gives him all the published data, without that analysis of conflicting results from which he can then make his own choice.

Sufficient has been said to indicate the value of this work to any physics library. There remains only one point on which the reviewer wishes to express his personal views. The author states in his preface: "In writing a book of this scope it is obvious that too much emphasis cannot be spared for style or for a detailed consideration as to the best organization in presenting the material. The need is for a critical compilation of the state of physical knowledge in the various fields to-day." One can appreciate the task of analysing and correlating the mass of data provided in this volume. But to the reader himself style and presentation of material are very important, and he may feel that had the author been in a position to spare the time, the volume could have been pruned without loss of conciseness and with some improvements in its arrangement. Again, the use of italics for purposes of emphasis is valuable. But when it is used fifty times in ten pages (pp. 419–428, taken at random) its effect on the reader may not be quite what the author intended.

AN INTRODUCTION TO MATHEMATICAL ANALYSIS

Advanced Calculus

By Dr. C. A. Stewart. Pp. xviii+523. (London: Methuen and Co., Ltd., 1940.) 25*s*.

WITH the ever-widening scope of modern mathematical analysis and its many ramifications, it is quite impossible to include, in a single volume of reasonable size, an adequate and exhaustive discussion of the calculus in its more advanced stages. It therefore becomes necessary, in planning a thoroughly sound course in the subject, to consider several important aspects of the vast field confronting a modern writer. The limitation of space renders the selection of subject-matter fundamentally dependent upon the aim of the course, which may or may not be related to the content of specific examination syllabuses. Logical development, too, may lead to the inclusion of many topics which, at present, may only be of academic interest, while others, of greater practical value, may have to be omitted. The experience and training of the writer may also have, more or less, a bearing on both these considerations.

With such thoughts in mind, it is interesting to turn to Dr. Stewart's volume, in which a good course, especially useful to students reading for mathematical honours, is thoroughly well laid out. The author fully appreciates his difficulty in selecting from such a vast field for, in his preface, he states: "Although this book is intended for students who have already acquired some knowledge of the elements of the calculus, it must be regarded merely as an introduction to the more advanced parts of the subject."

Although the subject-matter of a first course is included, the earlier concepts, regarded as intuitively obvious in many cases, are later re-examined in order that they may be satisfactorily founded upon a rigorously valid basis. Space has, however, only permitted the author to deal with those fundamental theorems which are essential to the developments considered or are likely to be needed in important applications. The first five chapters are devoted to the usual rigorous course in calculus up to the integration of functions of one variable. Then follow chapters on Jacobians; indeterminate forms, maxima and minima; vectors, twisted curves and tensors; multiple integrals; functions of a complex variable, conformal representation and contour integration; infinite series, products, expansions, infinite integrals and non-convergent series, and finally, Bernoullian polynomials, gamma and beta functions, the formulæ of Binet and Gauss, and Dirichlet's integral. Only the simplest theorems relating to the theory of sets, Lebesgue integration, finite differences, tensors, one-one correspondence, analytic continuation, etc., have been given. Importance is rightly attached to the approximate forms of functions, approximate integration and summation of series, but here again space has only allowed fundamental results to be dealt with.

From this very brief outline it will be seen that the scope of the course is wide. It has been skilfully planned and clearly presented, the diagrams deserving a special word of commendation. Many worked examples, often connected with important applications, are provided, and each chapter is supplied with appropriate exercises for the student's practice. Answers to these, where relevant, are also given.

It will be observed that no attempt has been made to include the theory of differential equations or of the functions that arise directly from them. It is hoped, however, that Dr. Stewart will consider the possibility of providing a companion volume devoted to this essential subject for, in the modern exploration of analysis, there is a tendency to overlook the supreme practical importance of this branch of mathematics, which really forms the very foundation of the higher stages of applied science. Such a volume would certainly be needed to supplement much of the present course by students reading for honours in science, notably physics.

SCIENCE AND NATIONAL WELFARE*

By Sir William Bragg, O.M., K.B.E., F.R.S.

Many events conspire to make the past year notable in the history of the Royal Society. Reference has been made to the majority of them in the Annual Report of Council, usefully supplemented by the Notes and Records which we continue to owe to our past Treasurer, Sir Henry Lyons. I do not propose to speak of them in detail, but on this occasion it does seem fitting to give further attention to one or two general matters of lasting interest.

One of these is personal. Fellows will have noted the long list of those whom we have lost, and the great names which the list contains. I have felt as I have been reading it that I have turned over the last leaves of a chapter that stands by itself. The present generation is quick to honour the names of J. J. Thomson and Oliver Lodge; but they cannot remember, as we older men can, the brilliant years when these men and their contemporaries were writing the chapter's first pages. What they wrote was eagerly read, their lectures were heard with rapt attention; they were the pioneers, and the men of science of that time, nearly half a century ago, streamed after them. All that is now a memory. The years have slipped away since their work was done, and we now look back on it as a separate entity, a noble event in the history of science, and of British science in particular.

There is no vestige of sadness in such a retrospect, nor any trace of feeling that our pride must be founded only on what has passed. I am sure that all those who like myself can recall the long years, and compare those that have gone by with those that are still ours, will say happily and proudly that our young men of to-day are maintaining in full force the tradition that they have received. They are writing a new chapter; and it is a chapter of a novel importance, because as they extend our record of the facts of Nature they find themselves compelled at the same time to consider a new problem—the relation of those facts to society and to the government of nations. Let me express my admiration of the willingness, vigour and ability with which the newer generation gets to work.

This same novelty is enlarging the range of work of our Society and is a second matter to which we are compelled to give serious attention. Our fellows have constantly given their services to public interests; it has often been pointed out that they are to be found in association with almost every department of government. But this year new moves have been made which may, and I hope will, lead to developments of the highest importance. The Report contains a notice of the recent formation of a Scientific Advisory Committee over which Lord Hankey presides, with a reference which in effect directs it to consider the advances of science in their relation to national welfare. The Committee reports to the Cabinet through its chairman. A Committee of similar nature but lesser scope was set up a few months ago to consider the scientific aspects of the food policy of the Government: it consists of well-known authorities on nutrition, agriculture and economy, with myself as chairman. This Committee reports to the Lord Privy Seal, and so to the Cabinet Food Policy Committee over which the Lord Privy Seal presides. The significant feature of these Committees is their close and direct association with the Cabinet, the central body that governs the nation.

Hitherto men of science have been appointed man by man to various Government departments so that they might act as useful items in departmental machinery. The new Committees are not parts of any executive body and have no executive power of their own. They exist to make recommendations, which must of course be practical and take full account of difficulties of execution. But they are not hampered by traditions, nor by set habits; they have time and freedom to consider the whole field of scientific knowledge and its possible influence on practice. The Scientific Advisory Committee, the more important of the two, is particularly well fitted to watch all occasions and opportunities for the employment of science in the service of the nation, and also for the continuous encouragement of that employment. The president of the Society and the two principal secretaries are in close touch with every branch of science; through the fellows of the Society which they serve they have a unique view of scientific progress. The three secretaries of the

* From the presidential address to the Royal Society, delivered on November 30.

principal Research Councils of the Government, dealing with industry, agriculture and health, are in close touch with the chief national activities.

Thus a great opportunity is opened after long expectation; and the Royal Society is largely responsible for the development of that opportunity. We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within.

We remember that it is science itself, not men of science, that we are trying to lift to the high places. In that respect our movement is not selfish. We do not claim that men of science shall be entrusted with authority because they are men of science: we do claim that authority shall be exercised in the light of a knowledge which grows continuously, and with continual effect on politics, on industry, and on thought itself. If at present the only way to bring this knowledge into use is to treat men of science as consultants, let us take that way. But we shall be taking the better way if in all ranks of the State, and especially in those that have authority and set an example, we can arouse a general appreciation of the position of, and a constant understanding watchfulness on, the increase of knowledge and the uses that are made and can be made of it. It cannot be said that the general aspect of the nation towards the increase of knowledge is satisfactory. Science has become an integral part of our educational system, yet the changes that have been made are often ridiculously like the casting of sacrifices to following wolves. Science is not a devouring monster, but a means of service; it is a knowledge, gained by an irresistible tendency of man to examine his surroundings. It may be rightly or wrongly used. There is a prime danger if those who are in the position to use it rightly shut their eyes to its presence and its power, like an army which relies on bows and arrows when its enemies know how to use machine guns.

It is not universally or even sufficiently understood how important natural knowledge has become. It is true that in a vague way the nation is brought by the happenings of war to guess at the meaning of scientific research in every kind of enterprise. But still it would be difficult for most people to grasp the significance, much less the meaning, of the description of a fact like this: that the Royal Air Force could not carry out its operations without the knowledge resulting from the studies of cathode rays and electrons made by our physicists, which is equivalent to saying that by this time we might well have lost the War. Similar cases of cause and consequence could be quoted in numbers; they happen to be found more readily in relation to the sciences that deal with inorganic materials than those that deal with organic processes, and the military demand for physicists has been great because they are wanted to put physical discoveries into practice. But this discrimination is only accidental and temporary, and in fact the whole range of science is equally concerned.

Since experimental science has assumed such a commanding influence on all our affairs, so that we run the risk of great perils if we take no account of it, and leave its uses to others, let us say, less well disposed than ourselves, and, on the other hand, have opportunities of great benefit if we use it rightly, it becomes a first duty to direct our steps accordingly. Just as in former times schools and colleges were founded to train men for the service of Church and State, in ways which were appropriate to that high end, so now we have to see to it that the men are produced by our educational systems who can appreciate and act up to a new state of affairs. This can be done without jettisoning any of the fine instruction which has been a proud feature of our older systems.

I think that this is not essentially a matter of the rearrangement of school time-tables, or the building of scientific laboratories, though such tactical methods must have their due consideration. This is a personal matter, as has been the case with every great human movement. We have not to force the use of new tools, but to encourage and develop a new appreciation and a new attitude. Our best method, as ever before, lies in our own actions. If we, in the continually increasing contacts of men of science with public affairs, can show that we have something of great value to contribute, and that we give it freely, placing our individual interests below those of a greater purpose; if we try to understand the motives and principles of those whom we meet who may not see our vision, just as we may fail to appreciate theirs, then by so doing we have the best chance of bringing about the changes that we desire. It is the personal contact of the man of science, especially with those who are charged with duties to the nation, that is the moving force. That is where these new associations of science with government may mean so much, and shall mean it, if our devotion can achieve its purpose.

VENTILATION OF AIR RAID SHELTERS

By J. S. Weiner

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THE occupancy of air raid shelters presents, actually or potentially, many of the whole range of problems with which the practice of ventilation is concerned. The term 'ventilation' is here used to include heating and other air-treatment; it may be defined as 'the provision of air hygienically and physiologically adequate in quantity and quality'. In air raid shelters conditions arise which tend to reduce the efficiency of ventilation very considerably. While on one hand, the supply of air is hampered in a number of ways by safety requirements, the demand tends at the same time to be greatly increased. Structural alterations to places used as air raid shelters usually require the blocking or baffling of the natural airways; lighting restrictions interfere further with ventilating arrangements; the danger of gas attack may reduce the available air supply merely to the air capacity of the shelter. The fitting of ventilating appliances may entail some structural weakening of a refuge; and the dependence of most large plants on outside power is also a potential source of weakness. Furthermore, since in shelters the ordinary density of living-room occupancy is much exceeded, satisfactory standards of ventilation are distinctly more difficult of attainment.

The specific problems of ventilation in air raid shelters may be appreciated, first by a discussion of the general requirements for adequate ventilation, and secondly, by an examination of the practical measures available to implement these particular requirements. The great variety in situation and capacity of shelters, and the lack of data of actual atmospheric conditions and circumstances of occupancy, even of a few types, restrict the scope of the discussion to rather broad generalizations. Although research over the last twenty-five years has added greatly to the scientific basis of ventilation, it will be clear that many matters to be mentioned here stand in need of thorough investigation. It is to be hoped, therefore, that the Horder Committee will set under way a comprehensive inquiry into shelter ventilation which will serve both as the prerequisite to effecting improvements and as means to valuable new information.

The general requirements for satisfactory ventilation with reference to air raid shelters may be considered under the following headings.

Thermal Comfort

The older ideas on the subject of ventilation laid great stress on the carbon dioxide in the air. But it is now well recognized that in ill-ventilated and crowded rooms the excessive warmth and stagnation constitute the chief causes of discomfort. Nevertheless, conditions may well arise in which the concentration of carbon dioxide is of paramount significance in regard to the adequacy of the air supply.

For comfort, the air should be cool rather than hot, dry rather than damp, moving rather than still, and variable in movement rather than uniform and monotonous[1]. The feeling of warmth experienced is related to four physical factors which influence the rate and mode of heat exchange between the body and the environment. These are: the dry bulb temperature of the air, its relative humidity, the mean (radiant) temperature of surrounding surfaces and the rate of air movement. The interrelationship between these factors and the sensation of warmth and comfort has been studied by workers in Great Britain and the United States[2,3], and has recently been reviewed by Bedford[4]. Some or all of the factors have been combined either in indexes which give due weight to each component or in the direct measurements of specially designed instruments. In air raid shelters it is probably best to measure the separate factors and then to use formulæ which give a combined assessment, if this is required. The separate measurements will usually give the clue to the most useful course of action, and in many cases combined indexes or special apparatus offer no advantage over the simpler readings.

In the evaluation of the separate or combined factors influencing warmth recent work[5] is capable of useful application to the conditions in air raid shelters. From an inquiry in which more than 1,500 sedentary workers, normally clad and doing light jobs, were concerned, data have been assessed showing the influence of the separate factors mentioned above on the conditions necessary for comfort. When the air was relatively still, the radiant heat from surroundings small, and the relative humidity about 50 per cent, 86 per cent of the opinions showed that conditions of comfort exist within the zone of 62–68° F. dry bulb temperature. Higher air or radiant temperatures and relative

humidity increase the sensation of warmth, but they can be counteracted by the increased cooling effect of air movement. Cold sensations, on the other hand, may be due to increased air movement, to low temperatures of surfaces, or low air temperatures, and accordingly may be countered by higher air temperatures, or sources of radiant heat, and slightly by increased humidity. These findings relate to persons, mainly sitting, and doing very light work while wearing ordinary indoor clothing. In air raid shelters where people are at liberty to wear extra clothing to maintain bodily warmth, temperatures somewhat below those of the working 'comfort zone' will probably be endurable.

In air raid shelters all four factors are liable to considerable and sometimes independent variation, according to the outside thermal conditions, the rate of air change, the warming effect of the occupants, the length of occupancy and the heat transmission coefficients of the walls. In warm weather with inadequate ventilation and depending on the number of occupants, air temperatures of shelters will tend to rise to uncomfortable limits; this effect will probably be of less magnitude in underground shelters, since the walls remain appreciably cooler than the air[6]. The capacity of the ventilation and surroundings of shelters for removing bodily heat so as to prevent its undue accumulation is clearly one important criterion in assessing the permissible number of occupants and the length of stay. This basis has been adopted in the official publication referred to below.[13]

In cold weather the heat of metabolism of the inmates makes an important contribution to the warming of the shelter. If fresh air supply is poor or is deliberately reduced, the temperature may even become unpleasantly warm. But the closing up of all openings as a means to increased warmth interferes with other important objectives of ventilation. Hence extra warming must be sought rather in higher radiant temperatures or in heating the incoming air.

In inadequately ventilated air raid shelters, the continuous addition to the atmosphere of moisture from the expired air of the occupants will tend to raise the relative humidity. But as the walls of underground shelters are some degrees cooler than the air, the rise in humidity will be slowed by the surface deposition of moisture[6]. This will probably hold true also for surface shelters in cold weather. Nevertheless, accumulation of moisture in some circumstances may constitute an important contributory cause of discomfort. At temperatures above 70° F. with relative humidities above 70 per cent feelings of clamminess arise[5]. Below the lower limit of the comfort zone increased humidity is of less importance. Hence the necessity for dealing with this source of discomfort, by proper spacing, increased air change, and in some situations by absorption of moisture by dehydrating agents. Besides the comfort zone laid down by Bedford and his index for combining the various factors—'equivalent warmth'—the American 'effective temperature' scale which combines the effects of dry-bulb temperature, humidity and air movement[2,3] may be a useful one to adopt in shelters. The winter comfort zone in terms of effective temperature for British subjects is about 54–68° F.[5] The summer comfort zone is probably about 6° higher.

Freshness

The environmental factors which contribute to the impression of stuffiness or freshness have recently been analysed by Bedford and Warner[7]. Observations have shown that one of the important factors is the rate of movement of the air; at velocities below 20 ft./min., feelings of stuffiness are likely to arise. Not only the average velocity but also the variability of the air currents are important. The relative humidity should be kept below 70 per cent. Stuffiness can also be produced by the combination of cool walls and warm air. Yet another cause is the existence of temperature gradients, higher at head-level than at foot-level. In air raid shelters all these factors are likely to operate, unless adequate ventilating measures are instituted. High relative humidity, cool wall and warm air combinations, temperature gradients, were all noted in a recent investigation in shelters[6].

Freedom from Odours

In satisfactory ventilation, the cubic space per person and the supply of fresh air are arranged to keep the air free of objectionable odours. In fact this has been a main criterion of adequate fresh air supply for almost a century. American workers[8] have lately shown that the amount of fresh air required per person varies according to the amount of cubic space available; the ventilation requirement increases as the space per person decreases, and is also closely related to personal cleanliness. In ordinary circumstances 1,000–1,200 cub. ft. per head per hour will give good results. A reasonable lower limit would probably be about 600 cub. ft.

In air raid shelters objectionable odours arise from a variety of sources, and are to be associated with primitive sanitary arrangements, the presence and preparation of food and the crowding of the occupants. The sensitivity to odours varies considerably, and the harmful effects attributable to odours are probably only indirect, as for example, loss of appetite leading to other disturbances.

Measures to mitigate the nuisance include adequate spacing, and standards of air supply or air changes, and also the use of deodorants or volatile substances which 'mask' the smell complained of.

OXYGEN AND CARBON DIOXIDE

Although the old practice of prescribing standards of ventilation according to the concentration of carbon dioxide was based on a misplaced emphasis on the ill-effects of this gas, in air raid shelters the concentration may quite easily reach levels undesirable in themselves and indicative as well of gross inadequacy in comfort and epidemiological standards. The sensitivity to high carbon dioxide percentages in the inspired air varies among individuals, but beyond 2–3 per cent panting and distressed breathing are the early signs of the physiological effort made by the body to prevent the carbon dioxide tension of the blood from rising outside tolerable limits. With carbon dioxide above 6–7 per cent, symptoms of carbon dioxide excess become serious. In places where the carbon dioxide due to combustion and respiration is not being removed fast enough, progressive lowering of the oxygen content will also prevail.

High carbon dioxide concentrations will affect the body first; but the oxygen deficiency will in due course prove even more serious. At a concentration of 12–13 per cent oxygen, oxygen lack will be superimposed on the carbon dioxide excess. The sealing-off of shelters in a gas attack represents a situation where oxygen supply and carbon dioxide removal may assume an importance even beyond the dissipation of heat, since in underground shelters the rise in air temperature is not as rapid or as serious as that of carbon dioxide[6]. In a fully occupied shelter with all openings blocked, signs of distress became manifest after two hours, and absorption of carbon dioxide and release of extra oxygen from cylinders were necessary to prevent the ill-effects.[6]

Hence, for those shelters which are to be sealed against gas attack and are not provided with mechanical ventilation with filtration, careful calculation must be made of the rate of accumulation of carbon dioxide to set limits to the number of occupants and time of occupancy. In this connexion, 1 per cent carbon dioxide should be regarded as an upper limit, whilst in assessing 'ordinary' ventilation on this basis, 20 parts per 10,000 should not be exceeded. For the purpose of this calculation in the case of sealed shelters, the production of carbon dioxide can be taken at about 0·6 cub. ft. carbon dioxide per hour for a man sitting quietly. In determining the available air on the basis of the volume of the shelter, the fittings and volume due to the bodies of the occupants should be deducted, for in crowded shelters the proportion of non-available space is fairly high. In a steel shelter of gross capacity of 1,210 cub. ft., 200 cub. ft. had to be deducted for fittings and the bodies of the forty-five occupants[6]. An upper limit of 20 parts per 10,000, it can be calculated, means an air supply of about 400 cub. ft. per hour per person.

SPREAD OF INFECTION

The floor space and air supply influence not only the standards of comfort, freshness, and freedom from odour, but also the spread of communicable disease. Two modes of spread are recognized: dissemination by exhaled droplets and the aerial transmission of infective particles.

In both types space is of obvious importance. Vernon[9] mentions that for school children at least 180 cub. ft. per head is desirable and in theatre and assembly rooms not less than 90 cub. ft. In shelters in which 50 cub. ft. per person only may be available, it is clear that air exchange and treatment of the air will have to be adequate to compensate for the reduced accommodation.

What standards of fresh air supply should prevail to reduce the number and contacts of infective particles is not accurately known. A comparison between 900 and 1,700 cub. ft. of air per hour per person showed no effect of reduced ventilation on the incidence in respiratory illnesses amongst school children[10]. The ventilation prevailing in air raid shelters will fall in most cases well below the London County Council standard of 1,000 cubic feet per hour (the official recommendations allow very much lower standards). Air change may even become nil when air raid shelters are sealed off from gas attack.

Hence the use of air disinfectants becomes a most important measure for supplementing the available space and air supply. The relative merits of various air disinfectants have been the subject of recent research which indicates promising results from the use of several phenolic germicides and hypochlorite solutions[11].

The necessity of proper warming or cooling of shelters is of obvious importance also in relation to infection. Sudden chilling, due to cold walls, on one hand, and warm and humid atmospheres acting on the mucous membrane of the breathing passages, on the other, favour increased susceptibility to infection.

DUSTINESS

The presence of dust can contribute to bacterial pollution of the air. As an irritant to the nose and chest it can be responsible for sneezing and coughing, which in crowded shelters will be a main source of infective matter.

PRACTICAL CONSIDERATIONS

The attainment of satisfactory conditions of ventilation depends in practice, as the foregoing discussion of the basic physiological and hygienic principles has emphasized, on the mutually interdependent factors of spacing and air supply, and on the employment of various measures of air treatment. A two-fold approach to the problem of improving the situation in air raid shelters is thereby suggested: the allocation of space per person in relation to the available or projected facilities of fresh air supply and, secondly, the complementary institution of a number of procedures of air treatment.

A clear distinction must be made between the different systems of ventilation, since the particular arrangement available is the main factor determining the eventual occupancy. 'Mechanical' ventilating systems employ fans and accessory mechanical appliances for changing the air; in 'natural' systems the air is exchanged under the influence of naturally occurring pressure differences due to fires and other heating arrangements combined with the ordinary disposition of windows, doors and other openings. In air raid shelters the further distinction must be made, in either case, as to whether or not protection against poison gas is a feature of the ventilating system. In the case of 'naturally' ventilated shelters, protection against gas implies that the shelter can be made gas-tight, and consequently the limit of the available 'pure' air is represented by the volume of the shelter.

In a sealed shelter it is, of course, quite feasible to replenish the used air from cylinders of compressed oxygen or air as well as to remove accumulating carbon dioxide by means of a suitable absorbent. This *regenerative* method, which can scarcely be of widespread use, is well worth considering as an emergency measure in control posts[6]. Protection against gas may also be provided in mechanical systems of ventilation by means of suitable filters.

In general, it may be said that the permissible accommodation should be determined according to which of the four arrangements obtains, natural or mechanical, in either case whether gas-protected or not. In the case of mechanical systems it is obvious that the design and capacity of the plant permit immediate application of standards based on the hygienic considerations outlined above. The number of occupants in a shelter with known mechanical ventilation is readily stipulated. For naturally ventilated shelters it is, of course, very difficult to indicate in advance the details of suitable arrangements of doors, windows, space, etc. Here, pending direct investigation of the shelter itself, occupancy must be on the basis of a reasonable floor space, while accessory measures must be vigorously employed. When dealing with naturally ventilated shelters intended also to be sealed off, definite standards can be laid down beforehand, based on the dimensions of the shelter. As we have seen, it is easy to calculate the rate of accumulation of carbon dioxide and the density and time of occupancy before maximum standards are approached. In addition, the rate of increase of air temperature can also be estimated, so that the necessary surface area for heat dissipation up to a limiting temperature can be stipulated.

In accordance with these four situations, the official recommendations would appear to give reasonably good general guidance, although the standards in most cases are admittedly minimal. Air Raid Precautions Memorandum No. 10[12] lays down that in shelters naturally ventilated (and to accommodate more than twelve persons) there must be per person:

Not less than 6 ft. sq. of floor area.

Not less than 50 cub. ft. capacity.

Not less than 25 sq. ft. of all walls backed by earth.

These standards may be reduced to $3\frac{3}{4}$ sq. ft. floor area per person provided the shelter is ventilated mechanically at a rate exceeding 450 cub. ft. of air per person per hour.

The first set of provisions, having regard to the hygienic requirements set out above, would require the most efficient cleaning, disinfecting, and other local treatment of the air to counteract the low rate of ventilation and minimal spacing. First-hand investigation would indicate how sufficient in practice natural ventilation proves in the larger shelters inhabited on this basis. The value of accessory measures in relation to these standards should be ascertained in the light of practical experience, and both the standards and these measures improved if necessary.

The standard for mechanical ventilation of 450 cub. ft. per hour, even though a higher degree of crowding is permissible, would appear superficially more in accordance with general practice. Nevertheless, accessory measures, such as aerial disinfection and the allaying of dust are of first-rate importance.

For sealed (unventilated) and gas-protected mechanically ventilated shelters, standards of accommodation have been laid down in relation primarily to heat dissipation and carbon dioxide accumulation. These are set out quite comprehensively in Air Raid Precautions Handbook No. 5[13]. Depending on the dimensions of the room, the number of occupants permitted for 3 hours and 12 hours occupancy is shown in relation to sealed shelters or air supplied mechanically at 150 cub. ft. and 450 cub. ft. per hour. The square

feet of area allowance per person under these conditions are in general much more satisfactory as regards hygienic requirements, particularly protection from spread of infection. It might almost be suggested that all shelters should be assessed for occupation on the basis of the eventuality of gas attack. On the official standards, and in ordinary circumstances, standards of spacing and air change would be universally of a much safer order.

Whatever the conditions, there can be no doubt of the importance of utilizing every available method of improving the properties of the air by local and 'emergency' measures.

With regard to freedom from infection, such measures include the thorough cleaning of the shelters with soap and water, or the treatment of the floor with spindle oil, the removal of dust by vacuum cleaning, and, most important, the use of air disinfectants. Although other precautions, such as medical inspection, isolation of suspected cases and prophylactic inoculation are of great importance, their discussion is perhaps out of place here. The wearing of face masks in overcrowded shelters would seem to offer a good measure of protection against droplet infection and would seem well worth a trial. Such masks should not prove uncomfortable even for long periods if worn loosely, much in the style of a veil.

With regard to conditions of comfort and freshness, a number of useful measures may be suggested. In shelters in which the air is too warm, care must be taken that the natural air flow is not being obstructed. Wherever possible all openings should be used to their maximum advantage, and in cold weather unpleasant draughts along the floor can be avoided by the judicious placing of screens near the doors. The incoming air may be assisted by locating a source of heat under a chimney pipe or the emergency exit. An oil lamp used in this way would also provide some lighting and warmth. Oilstoves and electric radiators, or other heating appliances should be installed where air or wall temperatures are excessively low. A radiant source will be most useful where very low wall temperatures obtain. No braziers or slow combustion stoves should be used owing to the very great danger of carbon monoxide poisoning.

Discomfort due to stagnation of air and high air temperatures can be reduced considerably by stirring the air. Where electric fans are not obtainable an improvised fan may be operated after the fashion of the punkah. Stirring of the air will help to dispel undesirable temperature gradients and so reduce the sense of stuffiness.

Proper sanitary accommodation as well as restriction on preparation of food in the shelter itself are of first importance in dealing with smell nuisance.

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RECENT IMPRESSIONS OF WAR-TIME AMERICA

By Dr. Joseph Needham,
University of Cambridge

As the result of long-standing invitations to attend the Second Conference on Differentiation and Growth at Salsbury Cove, Maine, and to lecture at the Californian universities (Stanford and Berkeley) on my own subject, I spent a period of five months (June–October) last summer in the United States, during the course of which I visited some twenty universities and colleges. I was glad to take the many opportunities which offered themselves of speaking on the present position of science in Europe. In this I dealt both with the situation of science in British democracy at war, the organization of the scientific contribution to the national effort against the Nazi-Fascist powers, the effects on the universities and similar institutions, etc., and with the nature and origin of the Nazi attack on all free international science and scholarship.

There was, I came to feel, a very real need for this approach, in the United States no less than in Great Britain, for unfortunately the works of the Nazi writers who provide the theoretical justification for the attack on science have never been translated, are difficult to obtain either in

America or Great Britain, and hence are practically unknown in either country. Yet only by some acquaintance with the works of such men as Spann, Klages, and Blüher in philosophy; Marr, Jung, Haiser, Moeller-Brück, etc., in sociology; Brohmer in biology; Jaensch, Hommes, Krannhals and Schulze-Soelde in racialism; Rosenberg and Krieck in what can only be called Nazi "mythology"; Stapel and Freyer in ethics; and Leonard and Stark in the history of science—can one hope to appreciate the full iniquity of the power that has destroyed free science in Germany, laid waste the universities of Poland, now overshadows the centres of learning in the countries of western and northern Europe, and against which the British people alone now stand, backed by the people of the great sister nation of the United States of America.

In this approach, I analysed the sociological origin of Nazi-Fascism, growing up as it did in the "fear field" between the socialist East and the democratic capitalist West, bent on world domination, and bound by its own necessity to a more efficient militarism than any hitherto known. Hence its attack upon international science took the various familiar forms.

(1) Anti-intellectualism, for when the ideals of a State can no longer be commended to the people in rational terms, irrational emotionalism must be fostered, and all scientific scepticism combated.

(2) Racialism, the greatest scientific fraud yet perpetrated on humanity, for the units of the military machine must be convinced that they belong to a "master-race" fated to dominate adjacent "subject-races". This has involved not only the flouting of all scientific anthropology, but also the "principle of racial conditioning of scientific knowledge" according to which no valid scientific results have ever been produced except by "Aryans" and "the concept that twice two make four is somehow differently tinged in the minds of a German, a Frenchman, a Negro or a Jew" (Hommes).

(3) *Wehrwissenschaft*, the concentration of support for science only on destructive applications, and the withdrawal of funds, effort, and men from pure science—a process that has reduced Germany from a first-class scientific country to a third-class one in seven years.

(4) The leadership principle, contrary to all that we have come to know of human nature through twenty centuries, and based on the fallacy of "biologism", the idea that human society can be treated as if it were of the same order of complexity and organization as animal associations.

The reception accorded to these discussions in the United States was extraordinarily friendly and enthusiastic. It was noticeable, however, (especially where the audience was composed mainly of older people) that there was sometimes a preference for discussing the situation of science in Great Britain, and how help could best be given, rather than the nature of the threat to European science on the Continent. This may indicate a tendency in some Americans to throw Nazi-Facism together with all the European tyrannies that Americans have been traditionally accustomed to hate, and this in turn might lead to the conclusion that in the long run it would be better for America to accept the *fait accompli* of a fully Nazified Europe and 'do business' with the governors of it, just as Americans have had to do in the past with many regimes of which they personally disapproved.

In spite of the fact that Mr. Roosevelt, whose firm foreign policy has been so important, has been re-elected, this tendency will probably develop, and it is being fostered by the Vichy French and other "spurious continental nationals" in America who are being used as stalking-horses by the Nazis. I did what I could to counter it by pointing to the havoc made by Nazis in international science and the impossibility of American democracy being able to live for long in a world the rest of which, including probably South America, was dominated by victorious Nazism.

At the same time there are certain points of the policies of British Governments up to the present at which American criticism is often directed. There is a strong minority in the United States who intensely deplore the failure of Britain to come to a thorough understanding with the U.S.S.R. Furthermore, there is a general feeling among Americans that in spite of all that may be said to the contrary, justice is not being done to India. It is feared, moreover, that the conventional classical training of many of those in public positions responsible for the conduct of the present War does not fit them for appreciating and using to the full the capacities of British scientific workers both for offensive and defensive action.

One point which must be referred to here is the remarkable and charming enthusiasm with which Americans welcome English visitors to their campuses at times like this. As time went on, I came across an unexpectedly strong feeling that there might be a certain number of older scholars, perhaps rather in the humanities and some branches of mathematics than in the sciences (where some relation to the war effort is likely everywhere), having little or no teaching duties owing to the War, who might be evacuated to American campuses, on indefinite leave of absence from their own Universities, and on their normal emoluments, there to pursue their researches in

peace and quiet, and to act with British Government backing, as goodwill representatives from the Anglo-Saxon civilization of the Old World to that of the New. Prof. H. S. Taylor and Prof. O. Veblen of Princeton were especially prominent in proposing some such scheme. It remains to be seen whether anything will come of it. At the same time it should also be mentioned that American sympathy for the British cause is so great that if at some later date owing to destruction of laboratories by bombing it should be necessary to evacuate a good many British men of science to the New World, nothing could exceed the welcome they would receive from their American colleagues.

It will be generally admitted that the part which the United States is playing and will play in this War will (with that of the U.S.S.R.) go far in deciding the future of the world. Only by drawing on American arms production can we hope to put an end to the activities of Europe's newest and worst tyranny. Hence the extreme importance of Anglo-American relations. Unfortunately, it is not in accordance with the facts to assume that the enemy is not extremely active in putting his case, such as it is, in the United States. Although Nazism is genuinely unpopular there, there are many arguments of a fifth-column nature which are sedulously put about by Nazi agents (for example, that the Union of Europe is being achieved, and that the people are glad to have it so, if Britain would only cease her opposition) and British activity in countering this and presenting the true facts in America is on a ridiculously small scale. No one more than the Americans themselves would like to see a very great extension of our information services in the United States. But whatever is to be done should be done quickly, for the enemy never lets grass grow under his feet, and now that the isolationist-supported presidential candidate has been defeated, the enemy's efforts will be redoubled.

It would not be too much to say that upon Anglo-American, no less than upon Anglo-Soviet, relations hangs the outcome of the present conflict; and Anglo-American contacts of scientific men, with their closely joined traditions, and their common detestation of the Nazi menace to international science, are calculated most happily to improve them.

OBITUARIES

Dr. F. W. Edwards, F.R.S.

FREDERICK WALLACE EDWARDS was born at Fletton, Peterborough, on November 28, 1888. His unexpected death, following a comparatively short illness, occurred in November 15.

From the Cambridge County School, where Edwards had already displayed a marked attraction to both botany and zoology, he entered Christ's College, Cambridge, in 1906, and commenced reading for the Natural Science Tripos under Sir Arthur (then Dr.) Shipley. He graduated in 1909, was admitted the degrees of M.A. in 1925 and Sc.D. in 1931. For many years a fellow of the Royal Entomological Society of London and an honorary or corresponding member of numerous scientific bodies, he was elected a fellow of the Royal Society in 1938.

In 1910, Edwards joined the staff of the Department of Zoology in the British Museum, being appointed Assistant in the Entomological Section, thus realizing an ambition he had cherished from childhood; in 1937 he was promoted to be a deputy keeper of the Department of Entomology which had been created in the interval. He was given charge of the mosquitoes, the crane-flies, and the British collection. His industry and ability quickly won him a larger share of responsibility, and he extended his care to the whole of the Nematocerous Diptera. The selection of Edwards for this post was a peculiarly fortunate one. It was intended to carry on and extend the work of F. V. Theobald, the last volume of whose Catalogue of Mosquitoes (inspired by the work of Manson and Ross and the needs of tropical medicine) had appeared only a few months earlier, and it succeeded beyond all expectations.

Almost immediately Edwards flung himself wholeheartedly into the task, and from the very first his papers showed a mastery of his subject and a critical faculty scarcely to be expected so soon; within two years he had already published ten valuable contributions on the systematics of the Culicidæ of Africa, the Oriental region and Great Britain, including much needed synopses of all the known African species and their larvæ. Inevitably the African fauna made the most insistent calls upon his attention, and a long series of papers published in the *Bulletin of Entomological Research* kept both entomological and medical men in that continent abreast of the taxonomy of the family, the whole subject being brought comprehensively up to date in the last volume of the "African Mosquitoes" (published by the Trustees of the British Museum (Natural History)) now in the press. It was Edwards' one anxiety when taken ill that this volume should be complete, and it will prove a fitting coping-stone to his labours in this sphere.

It would be wrong, however, to assume that Edwards confined himself in the main, or even at all, to this important family of Diptera. Though the acknowledged master of them, he sometimes confessed that he was rather tired of them and their

'importance' and preferred other groups less insistent in their claims but more attractive in their purely scientific appeal, such as the fungus-gnats (Mycetophilidæ), crane-flies (Tipulidæ), the Blepharoceridæ, the remarkable larvæ of which cling to stones in torrential streams, fossil Diptera and the British fauna as a whole. On all these groups and many others he published freely and indeed by the end of 1932 over 270 titles stood to his credit, represented by more than 3,000 pages of print. As a testimony to his industry it is perhaps worth mentioning that to provide some of the illustrations in these papers he himself prepared 1,800 drawings and 400 photographs in his spare time. Since then very many more have been added.

In the course of his work Edwards visited many museums on the Continent and in America, studying the collections of earlier dipterists whose descriptions were only to be elucidated by the critical examination of their material. In addition, however, he led two successful expeditions. The first, to Patagonia, Chile and the Argentine, was to some extent inspired by a desire to test Wegener's hypothesis concerning continental drift, by means of a comparative study of the dipterous fauna of that region with those of Australia and New Zealand. It led to a far-reaching account of the "Diptera of Patagonia and South Chile" which has already run to more than 2,000 pages and awaited only Edwards' summary and conclusions, now sadly lost to us. The second sprang from a desire to investigate the relationships existing between the faunas of the isolated high mountain groups of East Africa, and was concentrated mainly on Mount Ruwenzori. The first fruits of this equally successful expedition have already been published.

As a colleague both in the field and the Museum, Edwards was an inspiration, almost a source of amazement. His early years at the Museum, where he found himself working with a colleague temperamentally his antithesis and employing methods of a bygone generation, were succeeded by the testing trials to which his conscientious objections to warfare forced him. There was, however, never a word of complaint or hint of bitterness; instead, he devoted himself with ever-growing intensity to his work. The fruits of his labour it is quite beyond the scope of this brief notice to catalogue, nor are they all to be seen in his published writings. There can be few dipterists the world over, be they professionals or amateurs, who would not acknowledge him as a leader, and freely admit themselves in his debt as much for friendly help and advice as for the more formal help of his synopses, catalogues and revisions. Working on an order of insects in which novelties are a commonplace, it would have been easy for him to become a 'describing machine'; as it was, he described upwards of 2,000 new species, but always these descriptions were incidental to constructive taxonomic work on larger units of classification. Hence in practically every group of Nematocerous Diptera studied by Edwards it is to him that one turns for means of identification. This is particularly true of the British fauna, the known extent of which he increased by some 500 species, nearly all of his own collecting. His untimely death when at the zenith of his career and with every prospect of many years of increasing productiveness is for dipterists little short of a tragedy.

N. D. RILEY.

Dr. S. P. McCallum

THE many friends of Dr. S. P. McCallum, demonstrator in physics at the University of Oxford, have heard with much regret of his death on November 16.

Dr. McCallum was well known for his many activities. He was in the New Zealand Army that fought in the War of 1914–18, and in 1920 he came to Oxford as a Rhodes scholar. He had a distinguished undergraduate career and obtained a first class in the final honours examination in physics and afterwards a research degree. He was elected to a fellowship at New College in 1928 in recognition of his research work, and shortly after to a University demonstratorship in physics.

Dr. McCallum's scientific work on the conductivity of gases was done at the Electrical Laboratory, Oxford. The investigations he made of the coefficients of ionization of electrons in monatomic gases are of much importance in the theory of conductivity. His work on the effects of impurities in gases and the remarkable differences which he observed in the forms of luminous discharges in different gases are also of much interest.

Dr. McCallum excelled as a teacher, and the personal interest he took in his pupils was very much appreciated. He also assisted in the general work of the University. For many years he was Junior Bursar of New College, and last year he was a University proctor. He will be greatly missed, not only on account of his scientific work, but also on account of his general interest in College and University affairs.

WE regret to announce the following deaths:

Prof. Emile Argand, professor of geology, mineralogy and palæontology in the University of Neuchâtel, aged sixty-two.

Mr. C. V. Bennett, past president of the Institution of Gas Engineers, on November 18, aged fifty-three.

Dr. Wilhelm Haberling, professor of the history of medicine in the Düsseldorf Academy of Medicine, aged seventy.

Prof. F. H. Herrick, emeritus professor of zoology in the Western Reserve University, on September 11, aged eighty-one.

Dr. P. A. T. Levene, emeritus member of the Rockefeller Institute for Medical Research, on September 6, aged seventy-one.

Colonel T. S. Sinclair, formerly member of Parliament for Queen's University, Belfast, on November 25, aged eighty-one years.

NEWS AND VIEWS

The Royal Society: Election of Officers

AT the anniversary meeting of the Royal Society held on November 30, the following officers and members of Council were elected: *President*, Sir Henry Dale, director of the National Institute for Medical Research; *Treasurer*, Prof. T. R. Merton, formerly professor of spectroscopy in the University of Oxford; *Secretaries*, Prof. A. V. Hill, Foulerton research professor, and Prof. A. C. G. Egerton, professor of chemical technology in the Imperial College of Science and Technology; *Foreign Secretary*, Sir Henry Tizard, rector of the Imperial College of Science and Technology; *Other members of Council*, Prof. P. M. S. Blackett, professor of physics in the University of Manchester; Prof. F. T. Brooks, professor of botany in the University of Cambridge; Dr. C. G. Darwin, director of the National Physical Laboratory; Dr. A. N. Drury, Huddersfield lecturer in special pathology, University of Cambridge; Dr. H. J. Gough, director of scientific research, Ministry of Supply; Prof. J. B. S. Haldane, Weldon professor of biometry in University College, London; Prof. I. M. Heilbron, professor of organic chemistry in the University of London (Imperial College); Prof. O. T. Jones, Woodwardian professor of geology in the University of Cambridge; Prof. R. T. Leiper, professor of helminthology in the University of London (London School of Hygiene and Tropical Medicine); Sir Thomas Middleton, chairman of the Agricultural Research Council; Prof. L. J. Mordell, Fielden professor of pure mathematics in the University of Manchester; Dr. C. F. A. Pantin, reader in invertebrate zoology in the University of Cambridge; Prof. H. S. Raper, Brackenbury professor of physiology in the University of Manchester; Prof. E. K. Rideal, professor of colloid science in the University of Cambridge; Dr. F. J. W. Roughton, University lecturer in physicochemical physiology in the University of Cambridge; Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University of Bristol.

Sir Henry Dale, C.B.E., Pres. R.S.

SIR HENRY DALE, the new president of the Royal Society, is now director of the National Institute for Medical Research, and was formerly director of the Wellcome Physiological Research Laboratories (1904–14). For ten years (1925–35) he was one of the secretaries of the Royal Society. Over a long period, and with a succession of collaborators, he carried out important researches on the effects of histamine, an amine derived from ergot. For this work he was awarded a Royal Medal of the Society in 1924. This was extended to the isolation of histamine and acetyl-choline from animal tissues. Much of his later work was devoted to the discovery of the part played by these and other substances in a large number of important physiological and pathological processes. Closely related researches were being carried out in 1924 by Prof. Otto Loewi, then of the University of Graz, and Dale and Loewi were chosen to share the Nobel Prize for Medicine for 1936. In the following year, Sir Henry was awarded the Copley Medal of the Royal Society. As head of the National Institute for Medical Research, Sir Henry has directed a large number of investigations both within and outside his own special field. Numerous investigators from many countries have worked under his guidance.

Science and the National Welfare

SIR WILLIAM BRAGG's presidential address to the Royal Society, delivered at the anniversary meeting on November 30, did not include the customary survey of a branch of science with which the president himself is particularly familiar, and it can well be understood that such a survey at the present time might have been impolitic, as well as occupying time of the president which is fully occupied in other directions. But Sir William did give an impression of the increasing part which science is taking in promoting the national welfare (see p. 731 of this issue). After a brief reference to the men of science—pioneers of modern developments—who have died during the past year, he paid a glowing tribute to the younger men who have followed in their steps, maintaining worthily the tradition they have received by the acquisition of new knowledge, and in addition, grappling with its relation to society and to government. This newer aspect of scientific activity has been reflected also in the Royal Society. Whereas formerly many fellows of the Society have given their services to Government departments as required, and will no doubt do so in the future also, men of science now have, in the Hankey Committee, appointed a short while ago, a small body of leaders in direct touch with the Cabinet. The Society is represented on the Committee by its president and two principal secretaries, and has thereby accepted the responsibility of seeing that scientific developments and science itself are brought into the counsels of the nation; and Sir William continued, "We hope that no hindrances from without may interfere with the Society's task, and we are determined that there shall be no lack of energy from within."

So Sir William Bragg laid down the office which he has held so worthily for the past five years. His presidency, which began in the years of peace, has extended over a period of growing anxiety for the progress of science, for the very existence of civilization itself, through the first year of a war between nations in which the whole of the forces of science are being mobilized by the combatants; and the appointment of the Hankey Committee is a recognition of this fact. But though it has required a world-wide catastrophe to raise science to the 'high places' of Government, Sir William has the satisfaction of

knowing that the end for which he has striven so worthily has been achieved; it is the task of his successors in office to see that the full weight of scientific knowledge is brought to bear on all the manifold problems, both in peace and war, with which the rulers of Great Britain are confronted.

The Universities' Debt to Greece

THE Vice-Chancellor of the University of Cambridge presided at a public meeting held in the Regent House on November 23 to support the cause of Greece in the War. He was accompanied by the Greek Minister, the Provost of King's College (Mr. J. T. Sheppard), Sir Frederick Maurice (principal of Queen Mary College, London), the regius professor of Greek (Prof. D. S. Robertson), the Lord Lieutenant (Mr. C. R. W. Adeane) and the Mayor of Cambridge (Mr. E. O. Brown). The Vice-Chancellor (Mr. E. A. Benians, master of St. John's College) spoke of the sympathy and regard with which Greece is regarded in Great Britain, and particularly in the ancient universities of the country. "Wherever universities exist," he said, "they live and work in a light first kindled on the soil of Greece. To that source they trace the freedom of mind and spirit, without which they cannot fulfil their true functions."

H E. the Greek Minister also addressed the meeting, which passed a resolution, put by Mr. Sheppard, in the following terms: "We, Cambridge residents meeting under the chairmanship of our Vice-Chancellor, being conscious of the inestimable debt which every civilized nation owes to Greece, salute in her the source and pattern of our own free institutions, teacher of wisdom from of old, and faithful mother still of arts and sciences. Mindful also of the special ties which bind the University of Byron to the living memory of Greek heroes, we desire to place on record our profound and grateful admiration for the magnificent loyalty and courage with which the Greeks, who have so often withstood alien invaders, have dared again to take up the challenge in order to preserve for the Greek nation its own hard-won independence and to secure for the future of mankind that spiritual freedom which the world first learnt from Greece." The resolution concluded by asking the Greek Minister "to convey to friends in Greece, particularly to the members of the University of Athens, this token of our loyal friendship, of our faith in final victory and of our pride that the British Commonwealth of Nations strives and will strive with Greece for the same cause."

La France Libre

IN France, in common with the other German-occupied countries, there is no longer any freedom of expression, which is the essential fundamental of true art, literature and science, and all that contributed to the high place which that country held in the world of learning is now suppressed. A few of the French intellectuals have escaped and on them will depend the carrying on of the torch of French culture and learning. In order to do this a monthly journal has been founded entitled *La France Libre* in which the records of work and expression of free thought of these exiles from France will be conserved. By this means free French learning and free French thought will be co-ordinated and kept in being until that time when France is restored to her former freedom and prestige; and indeed it can only be through efforts such as this, and of other intellectual exiles from the oppressed countries, that the individual science and culture of the nations of Europe will survive.

The journal has the support of leading British men of science and of letters, headed by Sir William Bragg, past-president of the Royal Society, and expressions of sympathy have been received from members of universities and learned institutions all over the British Isles, Canada and the United States. The first number, which was published on November 15, contains an article on "La Communauté universelle de la Science" by Sir Richard Gregory and twelve others covering a wide sphere of interest. The journal is addressed to all Frenchmen and all those who love France, and is deserving of every support. It is not to contain propaganda. The price is 2*s.* a number or one guinea a year; all particulars may be obtained from *La France Libre*, 15 Queensberry Place, London, S.W.7.

Social Progress

IN a paper "What is Social Progress?" contributed to a symposium on social progress in the *Proceedings of the American Academy of Arts and Sciences* (**73**, 457–472; 1940) Prof. L. J. Henderson points out that terms like justice and social progress are useless for clear thinking because they have no accepted fairly clear meaning and can only be given an arbitrary definition at the cost of strong persistent emotional opposition. Social change, however, is a fact, but there is no logical or scientific test of the desirability of social changes except in relation to an end or purpose for which the test is utility. Prof. Henderson suggests that, in a given place, at a given time, for a given end, there may be an optimum rate of change of a given thing and some day this will be a subject ripe for careful study. The conditioned reflexes of men, as they are at any given time and in any given place, will be seldom negligible. More often than not, when the end is survival they will be again, as they have so often been, in the forms we name loyalty, the bonds of family, the sense of kinship, love of country and religious devotion, powerful social forces, and dangerously lacking when in default. Prof. Henderson suggests that among the innumerable effects of science on society, some must be harmful, according to any definition, now or hereafter, to many individuals and to some societies. Moreover, the effects of science upon society may well be only implicit functions of the state of science, but explicit functions of the rate of scientific development. The same scientific development proceeding rapidly may have one effect, proceeding slowly another quite different effect.

A second paper in the symposium, by Crane Brinton, points out that not only the word 'progress' but also almost every important word we try to use in per-

forming logical operations on problems in the social sciences is subject to limitations, if less extreme, through lack of precise meaning. Mr. Brinton, reviewing the various meanings which progress has borne, refers first to the sense of improvement in a process or technique. Then there is the sense derived from theories of organic evolution developed in the last century or so, and finally the sense of moral or social progress. He points out that so long as the notion of progress is closely associated with our immediate notions of the difference between what is and what ought to be, progress will probably remain one of the most important ethical abstractions in common use. In a third paper, Prof. E. B. Wilson suggests that no scientific meaning can be attached to such a term as social progress until social science has advanced considerably further as a science, and social studies are unlikely to become scientific so long as the *mores* of our social scientists place brilliancy so far ahead of patience and generalities so far ahead of specification. We need a handbook of the social sciences which tells us what is true under what restrictive conditions. Until such coherent growth has begun and gained considerable momentum we shall probably not have the background on which to say what is social progress, and when social science has thus advanced we shall be talking rather in terms of various sorts of social progress and social retrogression.

The City and South London Railway

ON November 11 the City and South London Railway celebrated its jubilee. The one outstanding criticism of this railway which could have been made was that the designers of the new line built for conditions then existing, and failed to take into account the changes that would occur in a few years' time. For example, the tunnel diameter was much too small, so were the first locomotives, the trains and the cars. The diameter had to be increased in 1922, and extensions were made for the railway between Stockwell and King William Street. It would appear that the railway made too timid a beginning. The *Electrical Times*, which also began its career about fifty years ago as *Lightning*, has referred to its earlier criticisms of the railway, and points out that perhaps its promoters dared not venture too far on what, after all, was an experiment without precedent; for the City and South London was the first electric tube railway ever built.

The new rolling stock has been designed to obtain the maximum amount of seating capacity consistent with comfort, and also allows a very much greater standing space than the old rolling stock. It has not been possible to introduce the new stock gradually, as part of the improvement of this railway is the moving of the conductor rail from its original position centrally between the running rails to the standard position laid down by the Ministry of Transport, namely, 16 in. outside the running rail; 6,445 yd. of new conductor rail have been laid. In order to reduce noise to a minimum, the running rails have been welded into 315-ft. lengths, involving 544 welded joints. Noise-absorbing shields are also being experimented with. These shields are fitted between the lower portion of the coaches and the tunnel walls. The City and South London is London's shortest tube railway. It is only 1 mile 46 chains long, and forms part of the quickest route from the heavily populated south-western suburbs to the very heart of the City. The journey only takes five minutes. The line was opened in August 1898, and carries an average of 30,000 passengers daily, most of them during the business rush hours. Nearly 40,000 yards of cables and wires have been laid in the course of the improvements.

Fitting Schoolboys for the World of Work

"GUIDANCE Programs for Rural High Schools", by Mr. Paul Chapman (Washington, D.C. 10 cents), is a bulletin belonging to the 'Occupational and Guidance Service' established by the U.S. Office of Education in response to a widespread demand. It has been revised after critical comment on a limited edition and shows once more the great elaboration of American education. High schools in rural districts have comparatively few pupils; but, as the foreword points out, they are important for society as a whole, because "no large city in our Nation is producing enough children to maintain its population". Local conditions impose differences of training and the two models noticed in detail from New York State are much larger than the average rural school. But one of them is described as "basically agricultural" and both can supply selections of things worth doing. All schools of the sort can go in for "occupational information, the personal inventory, counselling, exploration, use of training facilities, placement, and follow-up". This last word means close attention to pupils after they have left school.

To keep all these activities going lays a heavy burden on teachers. At Nyack School "counselors" have a great deal to do. They interview employers and make a monthly report. Personal data are supplied concerning pupils seeking work; former students have a two-page questionnaire sent to them; and their employers are expected to say how they are getting on. It is evident that this wide vigilance must produce good results and reduce the number of misfits who are "everything by starts, and nothing long". If all teachers did anything like as much, they might steady those restless adolescents who do little good for themselves or anybody else and often end on the dole. The programmes offered go right to the root of unemployment, but they demand a good deal of time and patience.

Ferns of Wales

INTEREST in the British native flora and in the study of botany in general is so admirably stimulated and encouraged by the excellent series of exhibits in the National Museum of Wales that the descriptive handbook of Welsh ferns by Mr. H. A. Hyde, keeper of botany, and Mr. A. E. Wade, assistant in the Department, is assured of a wide welcome (Welsh Ferns: a Descriptive Handbook. By H. A. Hyde and A. E. Wade. Pp. x+132+11 plates. Cardiff:

National Museum of Wales and the Press Board of the University of Wales, 1940. 5*s*.). Like its two predecessors dealing with the botany of Wales, published by the Museum, it is a most useful volume, and both text and illustrations leave little to be desired. The introduction conveys all that the student needs to understand the fern's life-history, and in the more detailed descriptive portion the keys and descriptions, aided by the clear text figures skilfully drawn by Miss E. A. Jenkins, should enable anyone to identify and discover all there is of interest in our native ferns. Now that so many name changes have taken place, one would have welcomed the inclusion of some of the old names—now synonyms—with which older botanists are more familiar.

Utilization of Sun Power

GENERATION of electrical energy direct from the sun's rays has been feasible for many years, but in most cases the price is quite prohibitive. Up to a few years ago, such installations took up so much space and required such a high expenditure per horse-power on apparatus that projects suggested were not inviting. Most engineers took this view and regarded them as only of academic interest. Recent advances in the treatment of aluminium, in vacuum jacketing, in flash boilers and in mechanism for following the sun on its daily course have put a different aspect on the problem of solar steam-raising plant. Dr. C. G. Abbot, secretary of the Smithsonian Institution, Washington, D.C., who is well known for his solar investigations, now states in the course of an article covering some six pages (*J. Amer. Inst. Elect. Eng.*) that power from the sun can be obtained at 0·5 cent per h.p., which is the pre-War equivalent of one farthing. He estimates that at this price such schemes can give a good return on investment. Even if we apply the corrective factor which is usually necessary in estimates by enthusiasts and raise the farthing to ½d. or ¾*d*., sun-power is obviously becoming a business for hot climates, and developments are worth watching.

Health of New Zealand

ACCORDING to the Director-General of Health, in 1939 the death-rate of New Zealand with a population of a little more than 1,500,000 (including 80,000 Maoris) was 9·20 per 1,000 population (excluding the Maoris) and the infantile mortality (with the same exclusion) 31·14 per 1,000 live births. The birth-rate was 18·73 per 1,000 of population. Heart disease was the principal cause of death, and cancer, from which there were 1,815 deaths, came next. The incidence of infectious diseases was low, but their notification among the Maoris had increased. The nutrition of the majority of school children was satisfactory, but there was still some evidence of subnormal nutrition. Maternal deaths due to pregnancy or childbirth other than deaths from septic abortion numbered 85, a death-rate of 2·95 per 1,000 births, as compared with 2·80 for England and Wales in 1938. There were 147 cases of puerperal sepsis notified. The rise in the number of deaths due to this cause has been attributed to the wrongful use of sulphonamides resulting in a granulocytosis. The maternal mortality among the Maori women, a large number of whom are still delivered by native methods, was 4·13 as compared with 5·41 the previous year.

Health on Gibraltar

THE report for 1939 of Major R. A. Mansell, the medical officer of health of Gibraltar, of which a summary appears in the *British Medical Journal* of November 2, states that among the civilian population the birth-rate was 20·85 per 1,000 and the death-rate 14·25, which were both larger than in most English towns. The infantile mortality, which has been rising steadily in recent years in association with gross overcrowding, was last year 79·36 per 1,000 births and was the highest since 1928. On the other hand, Gibraltar has been singularly free from epidemic disease. During the year there were only 93 cases of notifiable infectious diseases, the lowest number for half a century, and more than a third of these were chicken-pox. There were ten deaths from pulmonary tuberculosis, the prevalence of which is causing the medical officer some disquiet.

Bibliography of Seismology

THE *Bibliography of Seismology*, covering ninety-eight items for the period April, May, June 1940, published by the Dominion Observatory at Ottawa and compiled by Ernest A. Hodgson, has just been received. It is an invaluable reference work and contains items from most countries concerning studies of individual earthquakes, seismological apparatus, seismic prospecting, rock bursts, travel-time tables, tunamis, and many kindred subjects. A list of six patents for apparatus chiefly in connexion with seismic surveying is listed. All are American patents. References are given to seismological and geophysical publications in the *Proceedings of the Royal Society*, in NATURE, in the *Geophysical Supplement of the Royal Astronomical Society* and other British periodicals.

Announcements

IT was announced in the *London Gazette* of December 3 that the King has approved the award of the George Cross to Dr. A. D. Merriman, part-time experimental officer in the Directorate of Scientific Research, Ministry of Supply, "for conspicuous bravery in connexion with bomb disposal."

BY German decree the University of Leyden and the Technical High School at Delft have been closed owing to the "generally anti-German attitude of the undergraduates, and sabotage of the anti-Jewish measures". All professors of the Faculty of Laws of the University of Utrecht have been sent to concentration camps in Germany, while several professors of the Catholic University at Nijmegen, and of the Commercial High School at Rotterdam, have been arrested because of their loyalty to the House of Orange and openly admitted preference for a democratic system of government. A number of students at all these institutions have been arrested, fined, or sent to concentration camps.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Absorption of Cosmic Ray Protons in Lead

AT the suggestion of Prof. P. M. S. Blackett, we have recently investigated the absorption of cosmic ray protons in lead with a cloud chamber situated in a laboratory with a light roof.

The experimental arrangement is shown schematically in Fig. 1. Counters A, B, C, connected in coincidence, are placed above and below the vertical cloud chamber, *Ch*. Below C is a lead plate (s) 2 cm. thick, and a bank of counters D connected in parallel. ABC and D are connected to an anticoincidence set[1]. No particle which can penetrate s (that is, no proton of energy greater than $1 \cdot 5 \times 10^8$ ev. is recorded.

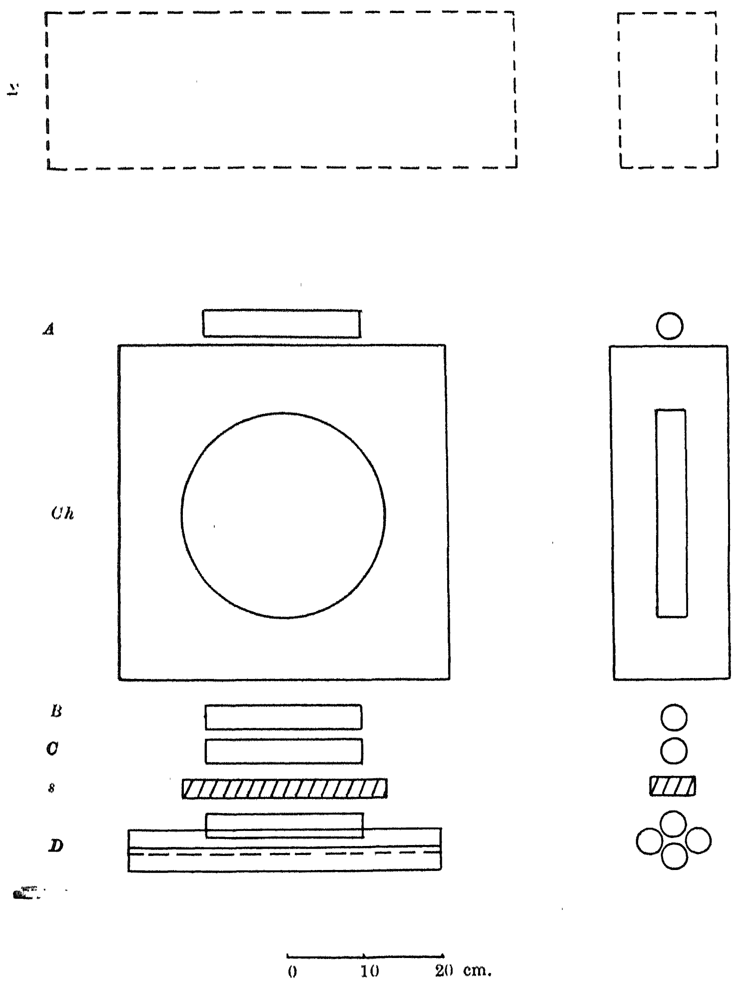

Fig. 1.

Protons are therefore observed only in the energy range in which they can be distinguished clearly from fast electrons and mesons. Slow electrons and mesons can be excluded for other reasons. Photographs and counts were taken alternately with (a) no lead ($\Sigma = 0$). and (b) 20 cm. lead ($\Sigma = 20$ cm.) above the apparatus. The results are given in the accompanying table, Only one proton, illustrated in Fig. 2, is found in 370 hours for $\Sigma = 20$ cm., whereas 8–12 protons are found in the same time for $\Sigma = 0$. The two figures quoted for $\Sigma = 0$ mean that of twelve tracks thought to be due to protons, eight are unambiguous. The figures for $\Sigma = 0$ compare favourably with those found by other workers[2].

The interpretation of the results depends partly on the assumed place of origin of the protons and partly on the form of their spectrum.

(1) If the protons observed in the cloud chamber come from a beam incident on the 'top' of the atmosphere, we compare in the experiment protons which initially have ranges (a) of 90–92 cm. lead, and (b) 110–112 cm. lead. Protons of this range have energies of the order of 2×10^9 ev. By analogy with the meson spectrum, one would expect the proton spectrum in this region to be fairly uniform, so that one would expect almost equal numbers of rays in both range groups. The fact that far fewer are observed with $\Sigma = 20$ cm. would mean that cosmic ray protons are absorbed strongly in lead.

(2) On the other hand, the results can equally well be explained if it is assumed (a) that the observed protons come from a group of protons of relatively short range; for example, less than 10 cm. lead, and (b) *either* more protons are found in air than in lead *or* the radiation producing the protons is filtered out by the lead (Σ). This latter would be true if the protons were produced by photon disintegration.

Some results of Anderson[2] are more in agreement with hypotheses (2) rather than (1). It appears, then, that the protons do not come from a beam incident on the 'top' of the atmosphere.

On one other point we would like to comment briefly. Both counts and photographs show that far fewer electrons are observed below 20 cm. lead than in air. These electrons are probably made up of (a) meson disintegration electrons, (b) meson knock-on

Σ (cm.)	Arrangement	Counts			Photographs					
								Analysis		
		Number	Time (hours)	Rate (c.p.h.)	Total number	Time (hours)	Rate (c.p.h.)	Singles	Showers	Blanks
0	ABCD	5257	802·7	6·6	2535	372·3	6·8	1622	219	694
	ABC	2457	85·8	28·7						
20	ABCD	1648	588·0	2·8	1042	369·2	2·8	589	103	347
	ABC	1094	52·0	21·1						

electrons, and (c) electrons from large cascade showers. The effect of lead will be to decrease the contribution of (a), since disintegration electrons are of short range (∼2 cm. lead), and probably to decrease the contribution of (b) since,

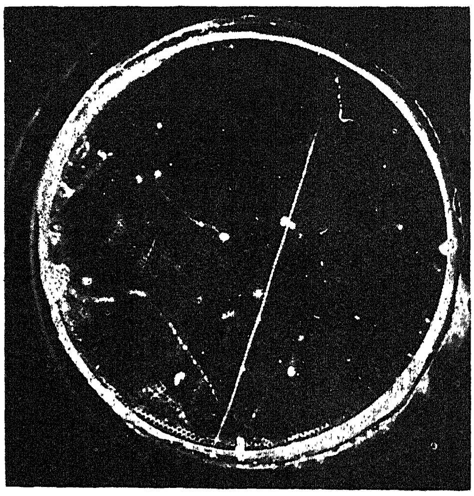

Fig. 2.

as Dr. L. Jánossy has pointed out to us, the meson will accompany the knock-on electron and thus prevent the electron from being recorded. Even if the contribution of (c) is the same, the total effect of the lead will be to reduce the number of electrons.

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M. BOUND.

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Manchester.
Nov. 15.

[1] Circuit unpublished. We are indebted to Dr. B. Rossi for the use of the anti-coincidence set.

[2] Anderson, C., *Phys. Rev.*, **50**, 263 (1936); Brode, R. B., Macpherson, H. G., and Starr, M. A., *Phys. Rev.*, **50**, 581 (1936).

[3] *vide* Anderson, *ibid.*, Heitler, W., Powell, C. F., and Fertel, G. E. E., NATURE, **144**, 116 (1939).

Occurrence of Vanadium and Molybdenum in Clays

THE occurrence of vanadium in clays has been known for some time, the amounts varying from a chemical trace to about 14 per cent[1,2,4]. Mellor devised a method for determining vanadium in the presence of titanium, but the surest test is a spectrographic one. Generally the percentage is less than 1 per cent and it is not known in what form it occurs. Callister[1] in Australia noted that vanadium compounds in kaolins are not water-soluble until the clay has been heated to temperatures of above a 1,000° C. I have found similar properties in South African clays. Many fire and building bricks made from clays of Karroo age exhibit a greenish-yellow or canary-yellow efflorescence, after weathering. The efflorescence is readily soluble in hot water. This efflorescence contains vanadium and molybdenum. Molybdenum is a much rarer constituent and is not easily detected in clays, by ordinary methods. In fact the only method appears to be, to heat large lumps of the material to temperatures of about 1,000° C. and then to extract with hot water and crystallize the salts in solution.

A partial analysis of the water soluble material from an under-fired firebrick gave:

MoO_3	.. .. ..	0·08 per cent
SO_3	.. .. ..	1·01 per cent
CaO	.. .. ..	0·28 per cent

the sample being dried at 110° C. A qualitative spectrographic analysis showed the presence of abundant sodium and vanadium and little else. Molybdenum was confirmed and iron was found in small quantities. It is noteworthy that while vanadium is easily detectable by spectrographic means, in the raw clay, molybdenum does not appear in the spectrogram. The concentration as described above must be done first.

It is possible that the vanadium and molybdenum compounds are contained in the clay complex and are not rendered soluble until these minerals are broken up. The crystals obtained from the calcination and water extraction treatment are birefringent and yellow-green in colour. They appeared to be perfectly homogeneous under the microscope.

The presence of molybdenum in mine, mineral and surface waters has been recorded by Novokhatsky and Kalinin[3], and they suggest its adsorption by freshly precipitated iron and manganese hydroxides.

Mr. Berkowitz directed my attention to this efflorescence, and his work, which preceded mine, had similar results.

V. L. BOSAZZA.

University of Witwatersrand,
Johannesburg.
Oct. 13.

[1] Callister, R. C., Bull. 27, Inst. Sci. Ind. Australia (1924).

[2] Palmer, L. A., *J. Amer. Ceram. Soc.*, **12**, 37–47.

[3] Novokhatsky, I. P., and Kalinin, S. K., *C.R. Acad. Sci. U.S.S.R*, **24**, 278 (1939).

[4] Bourry, J., "A Treatise on the Ceramic Industry" (1926).

Hydration of Carbon Dioxide and its Influence on Germicidal Activity of Hypochlorite Aerosols

WE are interested in the suggestion put forward by E. O. Powell in his recent communication[1], in which he stated that the effective bactericidal life of hypochlorite aerosols is dependent on "the velocity of changes occurring between the collision of carbon dioxide molecules in the air with droplets of the aerosol and the appearance of the corresponding H ions". The hydration process, it was suggested, might be slow compared with the former, thus becoming the rate-controlling factor in the bactericidal action of the aerosol.

When using an aerosol produced from a solution containing 1 per cent NaOCl, 16·5 per cent NaCl and 0·05 per cent Na_2CO_3, we were unable to detect any difference in the killing rate or the mean percentage kill (over a 30 min. period) of aerially dispersed *E. coli*; whether the tests were carried out in normal atmospheres, those to which 1 per cent carbon dioxide had been added, or from which the carbon dioxide had been removed[2]. (Our conditions may not have been entirely free from carbon dioxide, but the concentration must have been very much reduced.)

If the hydration of carbon dioxide is a slow process and the liberation of free HOCl dependent on this alone, then it might be expected that the hypochlorite aerosol would show a slow initial rate of kill which accelerates with time. Our experiments have shown that a good kill is obtained in the first five minutes and that the subsequent rate becomes slower; this is not necessarily in opposition to Powell's mechanism, which might take place within five minutes and have the effect of maintaining a fairly constant concentration of HOCl in the droplet owing to loss of the acid by evaporation. Evaporation of the water will, of course, reduce the amount of carbon dioxide absorbed by the droplet.

We have shown also that hypochlorite aerosols become decreasingly effective in acid, neutral and alkaline solution, although the neutral solution gave the best all-round results when the persistence of the action is taken into account. It was also found that HOCl as vapour is relatively ineffective. The action appears to depend upon the presence of free HOCl in the droplet, but not on either ClO^- or H^+ ions alone, since alkaline NaOCl or weakly acid solutions (free from NaOCl) are much less effective.

The addition of glycerol to hypochlorite solutions for use as aerosols seems to be of doubtful utility; it reduces the bactericidal activity of the mist, but generally increases its persistence, the increase given being governed by the particle size of the droplets. We have attributed the effect of glycerol to its effect upon the evaporation of water from the droplet. In bulk it was found that the presence of glycerol reduces the stability of hypochlorite solutions, especially if some acid is also present. The presence of a salt (for example, NaCl) has an effect somewhat similar to that of glycerol by retarding the evaporation of water from the droplet.

A. H. BAKER.
S. R. FINN.

Portslade Research Laboratories,
South Street,
Portslade. Nov. 1.

[1] Powell, E. O., NATURE, **146**, 401 (1940).
[2] Baker, Finn and Twort, *J. Hyg.*, **40**, 560–582 (1940).

Ionospheric Observations during the Solar Eclipse of October 1

DURING the total solar eclipse of October 1 ionospheric observations were made at three points in South Africa by the following three institutions: Cruft Laboratory, Harvard; Commonwealth Solar Observatory, Canberra; Bernard Price Institute for Geophysical Research, Johannesburg.

The results have revealed a marked ultra-violet light effect in the F_2 region. The maximum electron density in that region showed a decrease of about 20 per cent, reaching a minimum about 30 minutes after totality. There was no evidence for corpuscular effects. The behaviour of the E and F_1 regions was similar to what has been observed at previous eclipses.

J. A. PIERCE (Cruft Laboratory).
A. J. HIGGS (Commonwealth Solar Observatory).
E. C. HALLIDAY (Bernard Price Institute).
Oct. 14.

Termination of Optic Fibres in the Lateral Geniculate Body

IN a recent letter[1], Prof. Le Gros Clark directed attention to the evidence that crossed and uncrossed fibres of the optic tract each terminate in three alternating layers of cells in the lateral geniculate body in the monkey. Hitherto, however, this has been an inference based on the indirect evidence of transneuronal atrophy. It has now been finally established in this laboratory by the study of axonal and bouton degeneration, following section of one optic nerve. Seven days after this operation, the corresponding cell laminæ of the lateral geniculate body are filled with enlarged and grossly degenerating terminal boutons which are so conspicuous that they can readily be observed under low magnifications, and the affected laminæ thus contrast strongly with the normal laminæ.

P. GLEES.

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University of Oxford.

[1] NATURE, **146**, 558 (Oct. 26, 1940).

Molecular Fields of Force

MY article on "Molecular Fields of Force"[1] contains a misrepresentation of Prof. J. E. Lennard-Jones's work on this subject, which I much regret and wish to correct. In referring to the degree of ambiguity in his molecular models inferred from gas data, I stated that it remains uncertain whether the distant field is attractive or repulsive; this applies only to the determinations from viscosity data (and then only in certain cases); but not to his main and more important determinations from the equation of state. It is on these that he has based his valuable *applications* of the force-data, to explain many physical properties of solids and liquids as well as vapours.

S. CHAPMAN.

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South Kensington,
London, S.W.7.
Nov. 25.

[1] NATURE, **146**, 607 (1940).

RESEARCH ITEMS

International Standards for Biological Assay

AN inquiry on the assay of gas gangrene antitoxin (perfringens) carried out under the auspices of the Department of Biological Standards of the State Serum Institute, Copenhagen (League of Nations. *Bulletin of the Health Organisation*, **8**, No. 6, 797–912 (1939). Biological Standardisation, iv), reached the following conclusions. Perfringens antitoxins show the same activity when assayed against different toxins, if the toxins contain one and the same predominant antigen. The hæmolysin content influences the assay when the ratio minimum lethal dose/minimum hæmolytic dose exceeds 100. Intravenous assays on mice give results corresponding to those obtained intracutaneously on guinea pigs when pure ζ or ζ,α toxins are used. There is a relation between the activities of a perfringens antitoxin determined *in vitro* (hæmolysis) and *in vivo* only if pure ζ toxins are used in both tests. A perfringens toxin suitable for estimating the ζ antibody content in perfringens antitoxins has been prepared in Copenhagen and is at the disposal of institutes. The international unit for gas gangrene antitoxin (Sardelli) is defined as 0·1334 mgm. of the dry stable Washington preparation. Contributions towards the international standard preparations for (1) the gonadotropic substance of pregnancy urine; (2) the gonadotropic substance of pregnant mares' serum and (3) the lectogenic (crop-gland stimulating) substance of the anterior pituitary gland have been assayed in a number of different laboratories and the results analysed by C. W. Emmens of the National Institute for Medical Research, Hampstead, London. The international units for these three substances are respectively 0·1, 0·25 and 0·1 mgm. of the international standard mixtures. Suggestions for the use of these standards in biological assays are given.

Production of *pertussis* Antitoxin

EXTRACTS of *Hæmophilus pertussis*—the causal bacterium of whooping-cough—are toxic; they kill guinea pigs when a suitable dose is injected into a vein, and they produce necrotic lesions when injected into the skin of a rabbit. Investigation by independent workers of the problem whether the toxin can give rise to an antitoxin has led to conflicting opinions, and thus a recent paper by D. G. Evans (*J. Path. and Bact.*, **51**, 49–58; 1940) is of interest, especially since he, in collaboration with H. B. Maitland, had previously failed to obtain positive results. Evans now finds that rabbits, when immunized subcutaneously with the toxin, give definite evidence of having acquired immunity to it and that, moreover, the serum of such rabbits is capable of neutralizing both the necrotic and the lethal action of the toxin. A toxic substance with similar properties is extractable from *H. parapertussis* and *Brucella bronchoseptica*, and it has been found that 'pertussis' antitoxin is able to neutralize each of these toxins, a result which confirms the view that the micro-organisms from which they are derived are closely related to *H. pertussis*. An antibacterial serum against *H. pertussis* can be prepared in experimental animals by inoculating them intravenously with the whole organism or extracts from it, but this form of therapy has not been entirely effective in the prophylaxis and treatment of whooping-cough; nor has the serum from convalescent patients proved its value. The author considers that an antitoxic serum of high potency should be given a trial as a preventive and remedial agent in this disease.

Sunspots and Insect Epidemics

THE probable existence of some regularity in the fluctuations of animal numbers has been investigated by several workers. The results of such inquiries have not always been convincing, mainly perhaps on account of the difficulty of collecting sufficient detailed accurate records. D. Stewart MacLagan (*Proc. Univ. Durham Phil. Soc.*, **10**, 175–199; 1940) has collected data relative to severe insect outbreaks in Britain. A historical study during the past hundred years of outbreaks of such insects as flea-beetles, cutworms, leather-jackets, antler moth and diamond back moth has been made. On epidemiological grounds it is claimed that the frequency of outbreaks of the species just enumerated is correlated with the periodicity of sunspots. The years of maximum frequency are nearly synchronous with epochs of sunspot maxima. The connexion between sunspots and outbreaks is considered to be climatic; the favouring circumstances it is claimed are probably increased humidity and more intense ultra-violet radiation. The article concludes with a bibliography of seventy papers.

British Pyrenomycetes

Messrs. G. R. Bisby and E. W. Mason have performed a very considerable service to British mycology in compiling a "List of Pyrenomycetes recorded for Britain" (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 127–243; 1940). Taxonomy of all the Ascomycetes is still at a very low level, and any contribution is valuable. The present paper is more than the mere list implied by its title: it is a systematic evaluation of the Pyrenomycetes, and should pave the way for more detailed work upon the group, so urgently needed at present. The classification of Saccardo has usually been followed, and accordingly the Laboulbeniales, Gymnoascales and Perisporiales take their place along with the more obvious Pyrenomycetes. Detailed references are given, and an index to genera and species makes for easy consultation. It is greatly to be hoped that the superstructure of specific descriptions will follow this taxonomic foundation.

Triploid Sugar Beet

H. Peto and J. W. Boyes (*Canad. J. Res.*, **18**, 273–282; 1940) have shown that triploid sugar beet resulting from the cross $4x \times 2x$ differs considerably in sugar content from diploid beets. The root weights of triploid beets exceeded those of diploids by 12·2 per cent, in sugar content by 14·9 per cent and in dry top weights by 17·8 per cent. The decrease in sugar percentage for each 100 gm. increase in weight was 0·34 per cent for the diploids and 0·17 per cent for the triploids. The economic possibilities of triploid sugar beet appear promising.

Temperature Differences in Lakes

IN "Temperature Measurements in Vänern and Götaälv", Angström and Jacobson (*Med. fran. Stat. Met. Hydro. Anst.*, 7, No. 6; 1940) describe the work done at the instance of the Swedish Royal Board of Waterfalls through a commission appointed in 1929 for investigating certain problems of ice formation in connexion with the regulation of Lake Vänern. The work consisted of a study of the variations of vertical temperature gradient in the course of the seasons and the influence thereon of wind; the measurement of the temperature gradient extended from the vast and not very deep lake itself down to the mouth of the Göte River, where the salt water of the Skagerrack often flows as a bottom current in the reverse direction to that of the overlying fresh water. It was only in the latter region of the river that large gradients were found, with temperature differences between the bottom and the surface of more than 1° C., while in the lake the largest gradients were found only in the summer, late July providing differences of the order of 10° C. between the bottom and the surface where the depth is 35 metres. In contrast to deeper lakes, where the minimum temperature of the deeper layers at the time of ice-formation is often 4° C., the minimum in Vänern is then very nearly 0° C. at all depths. The observations explained the remarkable fact previously observed, that after the lake has been frozen over and covered with deep snow the temperature of the river often rises, so that the river becomes clear of ice during the later parts of periods of great cold. This is clearly due to the checking of outward radiation by the ice and snow over the lake, which permits heat from the ground beneath the lake to cause the temperature of the water to rise. This heating from below was the cause of occasional differences of more than 2° C. between the bottom and surface layers of the lake in winter, to be found only when the ice cover is thick. This publication concludes with an extensive bibliography of the subject covering the period 1900–32.

Thiophosphoryl Chlorofluorides

THIOPHOSPHORYL fluoride, PSF_3, is a colourless spontaneously inflammable gas, discovered by Thorpe and Rodger in 1888 and obtained by heating phosphorus sulphide and lead fluoride. H. S. Booth and M. C. Cassidy (*J. Amer. Chem. Soc.*, 62, 2369; 1940) have now prepared the two chlorofluorides $PSFCl_2$ (b.p. 64·7°) and PSF_2Cl (b.p. 6·3°) by the action of antimony trifluoride on thiophosphoryl chloride, $PSCl_3$, in presence of antimony pentachloride as a catalyst. Thiophosphoryl fluoride is also formed. PSF_2Cl, like PSF_3, is spontaneously explosive in certain concentrations in air. Thiophosphoryl chloride exists in two solid forms, freezing at −40·8° and −36·2°.

Convective Equilibrium and Solar Limb Darkening

A. D. THACKERAY has published a paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940) in which he shows the consequences of assuming convective equilibrium in the solar atmosphere when k, the mass-absorption coefficient, varies as p. The result of the analysis shows that both the darkening to the limb and also the distribution of energy in the spectra of disk and spot can be represented by the assumption of radiative equilibrium, or equally well by the assumption of convective equilibrium. In the latter case, however, it is necessary to assume that $k \propto p$ and also that γ is 4/3. These conditions may be realized at a certain level of the reversing layer or photosphere; but it must be admitted that they may not be true for the higher layers which affect the limb observations. In addition, there is no particular reason for adopting 4/3 as the value of γ, which represents the lower limit for a whole star. It is suggested that it would be interesting to repeat the calculations for other values of γ. An important conclusion on the equilibrium of sunspots is worthy of notice. Minnaert and Wanders made use of Milne's adiabatic hypothesis and applied two tests—the variation of the ratio spot/disk (1) from centre to limb, and then (2) in different wave-lengths. They concluded that neither of these tests was satisfied by the assumption of convective equilibrium in spots, but that both were satisfied by the assumption of radiative equilibrium. Minnaert and Wanders assumed the relation $k \propto p/T^{3/2}$, but on the assumption of convective equilibrium used by Thackeray he found that the facts could be equally well explained by assuming that spot and disk are both in convective equilibrium, or alternatively, that they are both in radiative equilibrium. Observations did not support the hypothesis that wave-length variations result from a convective spot and radiative disk, or from a radiative spot and convective disk.

Spectrum of Bright Chromospheric Eruptions

IT is well known that bright chromospheric eruptions on the sun produce definite effects on the atmosphere of the earth. From the nature of the effects it is inferred that the solar influence is transmitted by ultra-violet light and that the ultra-violet intensity in the eruption is of the order of a thousand times that normally emitted from the sun's surface. As it is impossible to photograph the short-wave radiation which is suspected of causing the ionospheric disturbance, owing to the earth's atmosphere, its nature must be a matter of conjecture. C. W. Allen, assuming that such great changes in ultra-violet spectrum would imply some corresponding effects in the spectral regions that can be seen and photographed, has described the results of his investigations on eruption spectra (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The observations were made with the 3-prism spectrograph of the Commonwealth Solar Observatory in conjunction with the sun telescope. The eruptions were set on the slit to give the brightest emission in $H\alpha$ or $H\beta$, and 116 emission lines were detected and tabulated in various discontinuous regions of the spectrum from 3922 A. to 6700 A. On comparing the intensities of the eruption lines with those of the flash spectrum, it was discovered that all Fe lines and all low *E.P.* Fe lines are strongly enhanced in eruptions. The enhancement of the former is also detected in metallic prominences and 'hot spots' (this name has been given by Cillié and Menzel to regions of the flash spectrum which have shown signs of unusual excitation), but this does not occur with the low *E.P.* Fe lines. It is a matter of some interest that in long-period variables of classes Me and Se several low-level Fe lines are emitted, while bright Fe^{+} lines are also present. It is possible to explain the small variations detected in the intensities of Fraunhofer lines from areas in eruption if the excitation temperature of the reversing layer is increased by about 100° K.

MEDAL AWARDS OF THE ROYAL SOCIETY*

COPLEY MEDAL

THE COPLEY MEDAL has been awarded to Prof. PAUL LANGEVIN.

Prof. Langevin was one of the band of young pioneers who, in the closing years of the last century, were engaged in exploring the field which had been opened up by J. J. Thomson's discovery of the electron. He spent a year (1897–98) at the Cavendish Laboratory, and his Paris Dr. ès Sc. thesis (1902) is dedicated to J. J. Thomson. The thesis, a notable one, was entitled "Recherches sur les Gaz Ionisés". It dealt mainly with the recombination and mobilities of ions, their coefficients and the relations between them. It is a standard work on this subject. In it he also devised and applied new and elegant methods of measuring these quantities which were an advance on all their predecessors and have not since been improved upon to any appreciable extent. Related to this, and coming later, were important contributions to the theory of the diffusion of gaseous ions and its relation to ionic mobilities.

Langevin's greatest achievement is the foundation of the electron theory of magnetism. The theories of paramagnetism and of diamagnetism are still very much as he made them and left them more than thirty years ago.

There are few branches of contemporary physics which he has not illuminated and improved by his writings, and his work generally has the qualities of breadth, clearness, elegance and completeness which stamp the master.

He has had a great international influence. He has been a prominent figure at all the meetings of the conferences arranged by the Institut International de Physique Solvay since they started in 1911. On the death of Lorentz he was chosen to succeed him as president of the above Institut.

He was awarded the Hughes Medal in 1915 and elected a Foreign Member of the Society in 1928.

[See NATURE of November 30, p. 715.]

RUMFORD MEDAL

The RUMFORD MEDAL has been awarded to Prof. KARL MANNE GEORG SIEGBAHN.

Prof. Siegbahn, member of an old Swedish family, is, in the field of X-rays, what Rowland was in the field of ordinary optics sixty years ago. He has introduced high precision into X-ray measurements. For example, the most accurate wave-length measurements in 1913 were those of Moseley, with an accuracy of about 1 per cent. By a brilliant succession of improvements in methods, design, inventions and technique, Siegbahn by 1924 had improved this to 0·001 per cent—a factor of 1,000.

Siegbahn is not only a great physicist, he is also a great engineer. He has made inventions and improvements in almost every useful type of apparatus connected with X-ray measurements, pumps, gratings, X-ray tubes, ruling machines, etc.

Among his many achievements are the determination of the structure of the L series of X-ray spectra, the discovery of the anomalous dispersion of X-rays (with Hjalmar), the accurate and direct measurement of the grating spaces of calcite and rock salt, and the selection rules for the frequencies of X-ray absorption edges. In conjunction with Larsson and Waller he was the first to deviate X-rays with a prism. They developed this method until they could obtain by it measurements of refractive indexes for X-rays which are of quite surprising accuracy.

In recent years he has been much occupied with the development and improvement of methods of measurement of 'ultra-soft' X-rays, the region between about 10 and 500 A., and with conspicuous success. This covers the gap between the ordinary X-ray region and the optical region of radiation.

He and his students have also been much interested in the values of the fundamental constants of physics and have made important contributions to our knowledge of them.

He has written a masterly book on the spectroscopy of X-rays. An extraordinarily large proportion of the information in it is due to the work of himself and his students. He has created an outstanding school at Uppsala and Stockholm, which now represents most of the physics of Sweden.

He was awarded the Hughes Medal in 1934.

A ROYAL MEDAL has been awarded to Prof. PATRICK MAYNARD STUART BLACKETT.

Prof. Blackett is especially distinguished for his work on cosmic rays and the particles connected with them.

The early work which first brought his name into prominence was concerned with the disintegration of nitrogen by α-particles; arising out of the experimental observations was the convincing proof that the disintegration process originated in the actual capture of the α-particle by the nitrogen nucleus.

The demonstration of cosmic-ray showers was one of Blackett's early successes with direct Wilson chamber photographs; but perhaps his most spectacular discovery—made simultaneously by Anderson in America—was that, in a large cloud chamber controlled by the tripping of counters, tracks appeared which could only be explained as due to a new particle—the positive electron. The importance of this discovery in the light of Dirac's theory was immediately realized by Blackett and his co-worker Occhialini, and important results have emerged.

Blackett also—in collaboration with Chadwick and Occhialini—extended the work on the positive electron, and it was soon found that there were sources other than cosmic rays. With the same collaboration Blackett was also instrumental in showing that quanta of sufficient energy could produce a pair of electrons, and this production was related to the so-called nuclear absorption of γ-rays—a phenomenon previously known but until then unexplained.

Blackett has followed up his cosmic-ray work and has published a number of very interesting papers dealing with various aspects of these rays. He has measured their energy, inferring therefrom a cosmic-ray energy spectrum; he has observed, with an extraordinarily high degree of accuracy, the scattering and energy loss of cosmic-ray particles in their

* From the remarks made by Sir William Bragg in presenting the medals for 1940.

passage through metal plates and has discussed the nature of the penetrating component of cosmic rays. Two papers on this topic appeared in the *Proceedings of the Royal Society* for 1938.

Lastly, reference must not be omitted of Blackett's important experimental contributions to our knowledge of the heavy electron—the particle which seems destined to be of such importance in the understanding of the more familiar nuclear particles.

A Royal Medal has been awarded to Dr. Francis Hugh Adam Marshall.

Dr. Marshall's earlier research work (1903–7) on the œstrous cycle, corpus luteum, and removal and grafting of ovaries laid the foundations for all the modern discoveries concerning the internal secretions of the sex organs.

The publication of his large text-book on the "Physiology of Reproduction", in 1910, stimulated work on this subject throughout the world, not only on points of scientific interest but also in regard to the application to medicine and to questions of fertility and milk secretion in the domestic animals. He was engaged on a third edition of this book when war broke out. He is generally acknowledged to be the father of this subject, and but few papers on this branch of science to-day are published without some reference to his work.

Arising out of his research, and that of his pupils, the importance of the anterior pituitary as a source of internal secretions, affecting not only the sex organs but also other body functions, has been recognized, and has led the way to an enormous volume of research work in recent years throughout the world. It is one of the subjects in which the greatest advances have been made in recent years.

Recently, his research has been concentrated on the exteroceptive factors, such as light, ultra-violet irradiation and nerve stimuli, which affect the sex organs by way of their effects on the anterior pituitary. This work explains the physiological basis for the seasonal and other changes which occur in reproductive activity. He summarized this aspect of the subject in the 1936 Croonian Lecture on "Sexual Periodicity and the Causes which Determine It", besides adding new matter.

Davy Medal

The Davy Medal has been awarded to Prof. Harold Clayton Urey.

Prof. Urey's first important piece of work consisted in carrying out extensive, accurate, spectroscopic measurements on diatomic and polyatomic molecules. This led him in 1931 to take up a detailed investigation on the abundance of natural isotopes of hydrogen, nitrogen and oxygen. During the next few years he succeeded in isolating deuterium and calculating the comparative thermodynamic properties of deuterium, hydrodeuterium and hydrogen. In 1934 he accomplished the first synthesis of deuteromethane.

Deuterium or 'labelled' hydrogen has proved of great value in investigating the mechanism of many organic and biologically important reactions, and its use has been the precursor of the modern general isotopic exchange reactions. A number of deutero derivatives have been prepared by Urey and his co-workers, and their entropies, vapour pressures and exchange equilibrium constants have been experimentally determined and compared with the theoretical values anticipated.

This isolation of deuterium from ordinary hydrogen and establishment of the thermodynamic, spectral and physico-chemical difference between it and pure hydrogen, as well as in the compounds containing deuterium and hydrogen, is a remarkably complete piece of work, for which Urey received the Nobel Prize.

More recently Urey has taken up the problem of the separation of the other important, naturally occurring isotopes: those of nitrogen, oxygen and carbon. He has examined their quantity distribution in Nature and employed exchange methods for the enrichment of one species.

Darwin Medal

The Darwin Medal has been awarded to Prof. James Peter Hill.

Over a long series of years Prof. Hill has carried out researches on the development of various mammals, particularly as regards the embryonic membranes and placenta, and added greatly to our knowledge of this subject. Many of his conclusions have clear evolutionary implications, as for example that marsupials are descended from oviparous ancestors with meroblastic ova. In his Croonian Lecture of 1932 Prof. Hill summarized his researches on the embryology and embryonic membranes of the Primates. The views of primate evolution based on development which he then put forward are in accord with those of Elliot Smith founded on brain anatomy, and of W. K. Gregory on morphological and palæontological evidence.

In collaboration with T. T. Flynn, Prof. Hill has lately (1939) published the first part of extensive researches on the development of monotremes, both Ornithorhynchus and Echidna, which will be of great value in helping to assess the origin and relationships of these egg-laying mammals.

Prof. Hill's research work is of first-class quality, being trustworthy and carried out with extreme care and the best techniques; it has never been scamped and is rich in original results over a wide field, most of the conclusions having a direct bearing on evolutionary questions.

Few living biologists have contributed more towards the solution of problems bearing on the interrelationships of the main groups of the Mammalia and on the phylogenetic history of the Primates, a subject with which Charles Darwin was so much concerned.

Sylvester Medal

The Sylvester Medal has been awarded to Prof. Godfrey Harold Hardy.

G. H. Hardy is the author, or part author, of more than three hundred mathematical papers, two books, and several of the Cambridge Mathematical Tracts.

Much of his work has been directed to the building up of the technique of modern mathematical analysis, and the simplicity with which the routine aspects of new work can now be presented is due very largely to fundamental results established by him.

It is characteristic of much of his work that it has stimulated others and has proved to be the starting-point of important developments. His work in collaboration with J. E. Littlewood on Tauberian theorems is an example. From an isolated classical result a subject was created which to-day would require a treatise for its exposition.

His most outstanding contributions to the advance of mathematical knowledge have been in the theory of the Riemann zeta-function and the theory of numbers. The achievement of which, it is believed, he himself is most justly proud is the invention of the 'circle method'. This is a technique of much beauty and generality, which brings great refinement of mathematical analysis to bear on a wide class of unsolved problems in the theory of numbers. The method has been elaborated and improved by other mathematicians, but on its account alone the name of Hardy must for all time rank high among the masters of his subject.

No appreciation of the services of Hardy to the advance of mathematics would be complete which did not attempt to assess the value of his personal influence. Throughout his career he has been the driving force behind a vigorous group of younger research workers. A very considerable proportion of the pure mathematical research now being published in Great Britain is traceable more or less directly to his interest and encouragement, or to the inspiration of his earlier work. His unstinted service during many years to the detailed work of the London Mathematical Society, and the freedom with which his experience and advice are available to all, have established him in a unique position in the regard of British mathematicians.

Hughes Medal

The Hughes Medal has been awarded to Prof. Arthur Holly Compton.

Prof. Compton has made a number of important contributions to physical science in the field of X-rays and elsewhere. Of late years he has been one of the leaders in the study of cosmic rays.

The experiments of Young and Fresnel early in the nineteenth century proved that light certainly had undulatory properties. But in the present century facts have been emerging, notably in connexion with photo-electric action, which are impossible to reconcile with the assumption that light can be described only as an electromagnetic wave of the classical type. These difficulties disappeared if light of frequency ν is assumed to be dynamically equivalent to a collection of particles of energy $h\nu$ (h is Planck's constant).

It occurred to Compton that from this point of view the interaction between radiation and free electrons is very simple, and in fact is the simplest interaction which radiation can undergo. Associated with the energy $h\nu$, according to the electromagnetic theory, there is momentum $h\nu/c$ (c is velocity of light). The interaction is thus reduced to a very ancient problem, that of the encounter of two infinitesimal billiard balls with known energies and moments. As the radiation moves with the velocity of light, in most cases the electron can be treated as if it were at rest. It is then obvious that in the collision the electron will acquire energy from the radiation, and the conservation of momentum requires that if the electron moves off in a certain direction the radiation will travel in a certain other direction. But reduction of energy of a quantum of radiation means increase in wave-length, and this increase will be a predetermined function of the direction of the 'scattered' radiation and of the direction of motion of the 'recoil' electron.

Compton published these conclusions in 1922. In 1923 he established the change in wave-length, first qualitatively by Barkla's absorption coefficient methods and then quantitatively with the X-ray spectrometer. In the succeeding years he investigated the energies of the recoil electrons as a function of their direction of motion and showed that the correlation, predicted by the theory, between the direction and energy of the recoil electrons on one hand and the direction and change of wave-length of the radiation on the other did in fact occur. This correlation is of fundamental importance in the general theory of the interaction of radiation with matter.

BIOLOGICAL APPLICATIONS OF SYNTHETIC CHEMISTRY

PROF. J. W. COOK, formerly at the Royal Cancer Hospital, who recently succeeded the late Prof. George Barger as regius professor of chemistry in the University of Glasgow, opened the winter session of the evening meetings in Edinburgh of the Pharmaceutical Society with a lecture on "Some Biological Applications of Synthetic Chemistry".

Prof. Cook said that many new facts have been recorded regarding the natures and the functions of substances which play vital parts in the process of life, and large numbers of these substances have been prepared artificially. Many rare compounds, not known in Nature, and yet possessing powerful biological activity, have arisen from the creative efforts of the synthetic chemist. The spectacular results which followed the introduction of the sulphonamide drugs were the outcome of purely chemical investigations. There is no doubt that prontosil, with its colourless prototype sulphanilamide, is destined to be regarded as one of the greatest boons to mankind conferred by this present age. Of the many thousands of sulphonamides that have now been prepared and examined, none surpasses sulphanilamide in efficacy against streptococcal infections. A later product, M. and B. 693, a sulphapyridine, has robbed pneumonia of much of its terror, and the analogous thiazole derivative has been claimed as effective against infections due to staphylococcus. These claims have not, however, been substantiated by tests carried out in Great Britain.

Much progress has also been made in other branches of chemotherapy ; new products are constantly being evolved which have therapeutic and pharmacological properties resembling, and sometimes exceeding, those of natural plant products. Carefully planned researches, such as those of the Drug Addiction Committee of the United States Public Health Service, should receive every possible encouragement. The very rapid decline in the use of cocaine as an addiction drug, after the discovery of synthetic substitutes such as procaine, gave a stimulus to efforts to solve the problem of drug addiction with the opium

alkaloids, and the efforts of the American investigators have been concentrated on a study of the pharmacology of a wide range of morphine derivatives and of numerous classes of synthetic compounds having structural features in common with some of those of the morphine molecule.

The chemotherapy of tubercular infections, Prof. Cook said, is now receiving increasing attention. Sir Robert Robinson has recently summarized progress made in this field, pointing out that in tuberculosis, as in leprosy, a suitable therapeutic agent should provide a means of penetrating or breaking down the waxy envelope which surrounds the bacilli of these infections. The active component of chaulmoogra oil, long used in the treatment of leprosy, is known to be a *cyclo*pentenyl fatty acid. Many synthetic analogues of chaulmoogric acid also possess leprocoidal activity, and the nature of these substances gives support to the view that they owe their activity to a capacity to effect impairment of function of the fatty envelope of the organisms.

Prof. Cook also reviewed in the course of his lecture the progress made in the past ten years in the chemistry of the vitamins and the members of the sterol class, including several groups of hormones. Most of the known vitamins, he said, have been isolated in a state of chemical purity, and the principal ones have been prepared synthetically; in addition, the biological role of several of them has been partially elucidated. The pure crystalline vitamin A was isolated for the first time only a few months ago. The other principal fat-soluble vitamin, known as vitamin D, is now available commercially in chemically pure form. Ascorbic acid, or vitamin C, is now available as a synthetic product. Incidentally, it has been claimed that vitamins A and C increase the body's resistance to infection; this, said Prof. Cook, is now disputed, although it seems likely that vitamin A, by maintaining the tone of the mucosa, renders these less liable to attack by pathogenic organisms. The principal members of the vitamin B complex have been synthesized and considerable insight gained into their biological function. Two other vitamins which have yielded their secrets to chemical investigation in recent years are vitamins E and K. The availability of the pure synthetic vitamins will hasten the solution of problems concerned with their biochemistry and mode of physiological action.

Remarkable progress has also been witnessed in the chemistry of a group of hormones which are related in molecular structure to each other and to cholesterol, which, Prof. Cook said, may be regarded as their biochemical progenitor. Except in the case of the œstrus-producing hormone, total synthesis has not yet been achieved, but members of these groups have been converted into common degradation products, and the steroid hormones have all been prepared artificially from cholesterol or other sterols. Deoxycorticosterone, the most active of the life-maintenance hormones of the adrenal cortex, has been isolated from ox adrenals and is now prepared artificially in considerable amount. It is concerned in the maintenance of the sodium chloride balance in the blood and has been found effective in the treatment of wound shock; for this reason its availability at the present time is of particular importance.

CONTROL OF INFECTION IN WAR WOUNDS

THE treatment and care of war wounds is essentially a bacteriological problem, as, indeed, experience in the War of 1914–18 made evident. The chief lethal micro-organisms that are found in infected wounds are *Streptococcus pyogenes* and the group of anærobic bacilli which cause gas gangrene. Researches within recent years into the causation of puerperal fever have shed light upon the origin of pathogenic streptococci in war wounds; in both cases the chief source of infection is regarded as being droplets of secretion that contain these microbes and that are expelled from the throat of those who nurse and treat the patients; the measure of the risk is given in the statement that 2–5 per cent of adults harbour *Streptococcus pyogenes* in the throat. Suitable masks should, therefore, be worn by all those who dress war wounds.

The danger from the intrusion of streptococci into wounds is likely to be much lessened by the administration of drugs of the sulphonamide group, although further experience is needed to define clearly the limits of their usefulness. The prophylaxis of gas gangrene is best attained by the early and adequate surgical cleansing of the wound and by the use of specific antitoxins corresponding to the chief types of pathogenic anærobe. The precise role of chemotherapy in combating infections caused by the gas-gangrene group of bacteria is still undetermined; recent experiments with laboratory animals indicate that the most favourable results will be obtained from combined sulphapyridine and antitoxin treatment. Tetanus antitoxin, which confers a passive immunity, still retains its place as an invaluable prophylactic agent; active immunization with tetanus toxoid—a non-toxic modification of tetanus toxin—was adopted last year as a voluntary method of protection for men in the Army and the Royal Air Force.

A small book on the subject, edited by W. H. Ogilvie and modestly styled a war primer ("War Primer on Wound Infection": its Causes, Prevention and Treatment. By W. H. Ogilvie, Robert Cruickshank, Lawrence P. Garrod, L. E. H. Whitby and G. A. H. Buttle. Pp. 96. (London: The *Lancet*, 1940.) 2*s*. 6*d*. net.) is the work of five recognized authorities, each of whom deals with a particular aspect of the treatment of civil and military wounds. The discussion is arranged under the chapter-headings: the problems to be solved; biological aspect; bacteriology; antiseptics; chemotherapy; surgical principles; and surgical procedures. The present state of knowledge has been set forth by the authors in a succinct and well-balanced manner. The facts they state and the conclusions they have reached deserve to be studied with the greatest care by everyone whose duty it is to assist in treating war wounds.

CULTIVATED CROPS IN EARLY ENGLAND

INVESTIGATIONS of a Danish committee appointed to inquire into the origins and development of agriculture in prehistoric Denmark have developed into a large-scale examination of recorded discoveries of prehistoric grain in northern Europe. In the course of this investigation, which has the support of the Rask-Ørsted Foundation, Dr. Hans Holbœk, on behalf of the Committee, visited a number of museums in England, Scotland and Ireland in 1939 for the purpose of examining the remains of prehistoric plants or their impressions on clay vessels from prehistoric and early archæological sites.

Pending fuller publication in collaboration with Prof. Knud Jessen, when that becomes possible, Dr. Holbœk has prepared a preliminary report on his examination of British prehistoric and Anglo-Saxon pottery in the Museum of Archæology and Ethnology in the University of Cambridge, which was completed only shortly before the entry of the Germans into Denmark (*Proc. Prehist. Soc.*, N.S. **6**; 1940).

The impressions found and indications of character, summarily stated, are as follows:

Emmer and spelt (*Triticum monococcum* Sch.). In bronze age barrows and the Late Bronze Age settlement of Mildenhall Fen in the form of impressions of grain and spikelets. *T. monococcum* L., the closely related small spelt, is also represented. Impressions of the threshed spikelets are characteristic.

Common wheat and club wheat. Distinguishable from emmer grains by their more rounded forms. As the evidence exists only in the form of charred grains or impressions, it is rarely possible to distinguish the race. In Cambridge there is only one impression of common wheat (*T. vulgare*), which comes from an Early Iron Age settlement (Abingdon), and the race seems to have been rare in early England.

Barley. As with wheat having a tough axis, the race of barley is difficult to identify. The prehistoric barley of northern Europe is the six-rowed form (*Hordeum polystichum* Doll.). It would appear that barley was always the chief grain of the Cambridge area. Naked and husked grains occur with equal frequency in the Bronze Age, but the husked form was almost completely predominant in Anglo-Saxon times.

Oats (*Avena sativa*). All impressions in the Cambridge material are of threshed oats, that is, without the husks and separated from glume and stem. Oats, presumably brought to Europe in the form of seeds, have been identified in the central European Bronze Age, and possibly were brought to Britain by the Romans. At Cambridge they are noted only in the Anglo-Saxon material.

Flax (*Linum usitatissimum*). Two flax seed impressions were found in the Anglo-Saxon pottery. In central Europe it is found in late Neolithic times, in Denmark from the Early Iron Age, and in Ireland on a site in Limerick of probably ninth–tenth century A.D.

Woad (*Isatis tinctoria*). Identified from impressions of the flat-winged fruit. In northern Europe it was cultivated so early as the Iron Age. The Cambridge evidence is of Anglo-Saxon date.

Investigations in other parts of Britain have established the fact that the knowledge of grain growing had already reached the British Isles in the latter part of the Stone Age.

FORTHCOMING EVENTS

Monday, December 9

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. W. G. East: "The Severn Waterway in the XVIIIth and XIXth Centuries".

Tuesday, December 10

CHEMICAL ENGINEERING GROUP in conjunction with the INSTITUTION OF CHEMICAL ENGINEERS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. A. B. Manning will open a Discussion on "The Salvage of Waste Materials in the Chemical Industry".

ROYAL ANTHROPOLOGICAL INSTITUTE (also for Members of the ROYAL CENTRAL ASIAN SOCIETY) (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—M. August Muhlenfeld (Director, West Indian Division, Netherlands Colonial Office): "The Badui: a Primitive Tribe of Eastern Java".

Wednesday, December 11

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. J. S. Nicholl: "Road Transport".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Mr. A. L. Bacharach: "Some Nutritional Problems of War and Peace".

Friday, December 13

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. S. Lall: "Industrial Development in the Indian Provinces".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER TO TAKE PHYSICS AND MATHEMATICS—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middx. (December 14).

GRADUATE TEACHER OF MECHANICAL ENGINEERING SUBJECTS—The Principal, Hendon Technical Institute, The Burroughs, Hendon, London, N.W.4 (December 14).

ADMINISTRATIVE ASSISTANT (MAN) FOR HIGHER EDUCATION—The Education Officer, Education Offices, Katherine Street, Croydon (December 16).

LECTURER IN PHYSICS AND MATHEMATICS—The Principal and Secretary, Harris Institute, Preston (December 21).

GRADUATE LECTURER IN THE MECHANICAL ENGINEERING DEPARTMENT of the Royal Technical College, Salford—The Director of Education, Education Office, Chapel Street, Salford 3.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 12: Organic Halogen Compounds. Pp. ii+6. (London: H.M. Stationery Office.) 2*d.* net. [611

Other Countries

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 11: Malayan Agricultural Statistics, 1939. By D. H. Grist. Pp. xii+102 tables. (Kuala Lumpur: Department of Agriculture.) 1 dollar. [411

U.S. Department of the Interior: Office of Education. Vocational Division, Bulletin No. 203 (Occupational Information and Guidance Series No. 3): Guidance Programs for Rural High Schools. By Paul W. Chapman. Pp. vi+58. (Washington, D.C.: Government Printing Office.) 10 cents. [411

Transactions of the Academy of Science. Vol. 30, No. 3: The Cytological Structure of the Hypothalamic Nuclei in relation to their Functional Connections. By Homer Dale Kirgis. Pp. 65–86. (St. Louis, Mo.: Academy of Science.) 50 cents. [511

NATURE

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Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Registered as a Newspaper at the General Post Office

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MACMILLAN & CO., LTD.
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LONDON, W.C.2

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Vol. 146 SATURDAY, DECEMBER 14, 1940 No. 3711

SCIENTIFIC SOCIETIES IN WAR-TIME

IN times of peace London is unquestionably the focus of the scientific life of the British nation and Commonwealth. The reason is not that London is the seat of the metropolitan university, though this, by its system of external degrees, is also in a special sense the central university of the Empire ; moreover, it enfolds within itself many special institutions, like the Schools of Economics and of Hygiene and Tropical Medicine, which are themselves imperial centres for special branches of science. Nor is it that London is the seat of the chief national scientific departments, like that of Scientific and Industrial Research, or the Medical and Agricultural Research Councils. London had attained its position as the national scientific centre long before these modern bodies had been constituted, and before the University of London had come to be comparable, in size and influence, with the older Universities of Oxford and Cambridge (though as a centre of medical teaching London had long been pre-eminent). During two centuries and more in which the venerable sister Universities were still unrivalled except by each other, as centres of learning and research, their scientific members found a common meeting ground in London, in the rooms of the Royal Society : and during the nineteenth century London became the centre also of many more specialized scientific societies.

The relatively small size of the British Isles, and the excellence of their railway communications, make it conveniently possible for those who follow any special branch of science to come together, from all parts of Great Britain, to meet in London several times yearly. In this respect British men of science have an advantage not enjoyed by their colleagues in greater and more widespread communities like those of the Dominions, the United States, the U.S.S.R., or even Germany. In these countries regional centres have consequently developed, and national meetings tend to be annual and peripatetic, like those of the British Association. Such regional centres flourished also in Great Britain in the days before speedy travel became possible, but except in Dublin and Edinburgh they seldom attained the distinction of some of the principal academies of Germany, and with few exceptions they have declined since the days, for example, when Dalton was the glory of the Manchester Literary and Philosophical Society. Some of the chief British technical scientific societies, however, have in modern times developed valuable regional activities, in centres where meetings are held in addition to those at their main headquarters in London.

While the present War was still only a threatening possibility, the controlling bodies of some of the national scientific societies tried to prepare for future eventualities by arranging for the transfer of their offices from London, the safeguarding of their most cherished property, and alternative arrangements for meetings, in case the expected *Blitzkrieg* on London became a reality. On the outbreak of the War, some of these plans were carried out ; in other cases the councils of the scientific societies met to consider whether or not their pre-arranged series of meetings should be held. There were pessimists who thought it would be useless and undesirable to hold meetings, because of the absence, or absorption in war work, of many members, including some of the leading personalities. But in the main such counsels were not followed, and many societies held their meetings as usual throughout the session, from October

or November until June, during the unexpectedly prolonged immunity of London from aerial attack. Towards the end of the 1939–1940 session, some of the societies reverted partly to their pre-War condition, by the return of their offices and staff to London, or by the partial reopening of their premises or library. Even through the dark days of the over-running of Norway, Denmark, Holland and Belgium, followed by the ominous signs of weakness that preceded the collapse of France, much of the scientific life of London was maintained. At the beginning of the summer recess there seemed hope that if the threatened invasion were forestalled or repelled, the autumn might see a resumption of London scientific meetings, little changed except for some decline in the numbers of those attending and of the papers presented.

In August, however, the long-postponed air attack fell upon London, and before the usual date of reassembly of the scientific societies, daily and nightly raids became a regular feature of London life. The question of the continuance of meetings has now acquired a more serious and perhaps controversial aspect in the new circumstances. Not only has the 'black-out' assumed if anything a deeper tinge than before, but also interruption and dislocation of road and rail transport has been caused from time to time by the enemy bombing. Especially after darkness has fallen and night raids have begun, travel is difficult and unpleasant, and late afternoon meetings, which in winter fall during the hours of darkness, are for this reason likely to attract few attenders. Still less likely is it that members would continue to stay to club dinners after such meetings, though in peace-time such dinners form a useful and pleasant supplement to the formal gatherings of the scientific societies.

The safest course would naturally be to discontinue meeting at all, at least during the darkest months of the winter. As a set-off against such a lapse in the ordinary activity of the societies, the sessions might be prolonged into what is in normal times the summer vacation, but which in these years of shortened or suspended holidays would be fully appropriate for scientific meetings. Some societies have already suspended their usual winter meetings, with or without an indication of the expected date of their resumption.

Others, bolder and (in the judgment of some) more admirable, are continuing to meet in London, either as usual or at an earlier hour, so that the meeting may be concluded before nightfall. In some quarters the holding of the regular meetings outside London has been considered, but except where societies have developed regional activities and centres in peace-time, it seems unlikely that such meetings would be so successful as afternoon meetings in London would be; this is partly because it remains much easier to travel to than any other centre, from places more than a few miles away, and partly because London and the surrounding counties still contain the largest number of potential visitors to scientific meetings. To those who live at a distance, in regions that have not suffered serious air attacks, it may seem to be merely foolish bravado to propose that scientific men should foregather in London; it should be remembered, however, that the millions of people who continue to inhabit the London area include many who would welcome scientific meetings not less than in peace-time, and who would feel no more in danger at such meetings than in any of the other places, of work or dwelling or recreation, which they frequent. This is perhaps insufficiently considered by some council members of scientific societies who, for whatever reasons, being unable or not wishing themselves to take part in such meetings, lend their influence to abandonment or postponement.

A more fundamental objection to the continuance or resumption of the winter scientific programme is raised in some quarters, as it was also in the War of 1914–18—that scientific meetings are intrinsically unjustifiable in war-time, being a misuse of hours that ought to be devoted to definite war work. This view ignores the fact that there are still many scientific workers, capable of helping to overcome our enemies, and anxious to be thus used, whose services have not been called upon, or have even been declined when offered. But even as regards those whose time is actively occupied in scientific war work, the criticism seems answerable. Neither manual nor intellectual workers can work all their waking hours; some leisure and refreshment of mind are necessary to enable a man to do his best work; and the solution of a pressing war problem may be facilitated, not retarded, by a break in the routine hours of labour, and by meeting with colleagues who share similar peace-time scientific interests, whether or not they are likewise now engaged in war service.

Almost all the general arguments that justify the expenditure of time and travel involved in attendance at scientific meetings in peace-time remain valid also in war-time. Just as a Christian

finds no less need now than in normal days to assemble in church with his fellow worshippers, so the man of science still needs to maintain his contacts with fellow workers and with scientific progress outside his own special activity. War is not exclusively a matter of the organization and execution of material defence and attack; the mind no less than the body and the spirit must be kept in sound condition in order to continue to develop these material measures.

The officers of scientific societies, however, doubtless find other obstacles to meeting than those of risk and travel difficulties. The work of scientific technicians is now largely directed to war problems the solutions of which must for the present be kept secret; and so many workers in pure science are now drafted into the technical defence services that the output of pure research which can be safely published in war-time is much reduced. These factors are in one way a help to societies, in reducing the pressure on their resources of money (and of paper) for publications; but unless the societies are to fall into a state of suspended animation that may seriously prejudice their future revival, some degree of publication must be continued. The volume and perhaps even the standard of the papers published and read may be somewhat reduced, but the sources are scarcely likely to dry up entirely; and a shortage of papers for reading at meetings can be eked out partly by a moderate reduction in the length of the meetings, and also by arranging discussions, a course which has been so successfully followed by the Royal Society in recent years.

ENTOMOLOGY OF STORED PRODUCTS

Insect Pests in Stored Products

By H. Hayhurst. Pp. xii + 83 + 49 plates. (London: Chapman and Hall, Ltd., 1940.) 15*s*. net.

AS a guide to the industrial chemist desirous of learning something of the appearance and mode of occurrence of the insect and arachnid pests of stored products this book is useful. The excellent illustrations by Mr. Harry Britten are numerous, the description of the insects is reasonably adequate, and the emphasis laid on cleanliness in stores and in vehicles of transport is sound. A list of "substances and their pests" is given as an appendix to the book and there is a short index of contents. The inclusion of the moths Plodia and Ephestia among the "substances" as "subject to attack" by the parasitic wasp Habrobracon is amusing.

Doubtless this book is, as Sir Harold Hartley points out in a foreword, intended for the industrial chemist. It is to be regretted that the author did not amplify on one hand, and simplify on the other, to meet the needs of warehouse managers, foremen and others who are the parties immediately concerned with infestation. While it is useful to have short descriptions of the insects infesting stores and warehouses, together with short accounts of the products on which they commonly occur, collected into a single small handbook, the most urgent need in combating insect infestation of food and other stores is a better understanding of how infestation occurs, and how it may attain an alarming extent and how only organized and concerted action can really cope with it. These matters are not discussed.

To the reader conversant with the literature, Mr. Hayhurst's sources of information are obvious; but he might have acknowledged them, including the source of material for Mr. Britten's illustrations, and in doing so have enabled his colleagues in the railway companies and elsewhere to read for themselves what is known of their problems and to keep in touch with the rapid progress in the understanding of them and towards their solution which is now being made. The early work of the Empire Marketing Board in this field is wholly ignored, although in his preface Mr. T. W. Jones refers to the subsequent work of the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades. The work of Drs. Page and Lubatti in the science and practice of fumigation is not even mentioned. The great improvement in insecticides for use in warehouses, achieved by Dr. Charles Potter, is referred to; but no mention is made of any of his papers on the subject, which are of high importance, both scientifically and practically.

It is a real defect in Mr. Hayhurst's book that no bibliography of the subject is given. The cost of the book is high, and, in the absence of references to sources of information whereby the reader could extend his knowledge, excessive.

One comment on Mr. Hayhurst's book may be made. It illustrates very well how, outside the research laboratories, the entomology of stored products is still in that early stage of development where description of the insects concerned and general recommendations about their control represent the knowledge apparently acceptable and

satisfying to those dealing with infestation. That there are scientific principles underlying the problems of infestation and the methods by which they may be solved is only vaguely realized. Nevertheless Mr. Hayhurst's book shows a real awakening on the part of the industrial chemists to the need for tackling their infestation problems seriously, and the author is to be congratulated on a highly creditable performance within the rather narrow and now old-fashioned conception of applied entomology as a branch of zoology concerned less with the discovery of new laws and principles than with the immediate control of noxious insects. We may look to the work of the new Pest Infestation Laboratory of the Department of Scientific and Industrial Research to dispose once and for all of that old-fashioned view, and to give the lead in industrial entomology which has been so long deferred in Great Britain and in the Commonwealth. J. W. MUNRO.

VEGETABLE PATHOLOGY

Diseases of Vegetable Crops
By Prof. J. C. Walker. New edition. Pp. iii+67. (Madison, Wis.: The Author, University of Wisconsin, 1939.) 1.75 dollars.

THIS publication is printed in the style known as typewriter type, being, in fact, a reproduction of the author's typed notes bound (quarto size) in stiff paper covers. It is doubtful whether this form of printing will be welcomed by readers, for the variation in ink density is tiresome and may even be tiring to the eyes.

The book is primarily intended for the use of advanced students of vegetable pathology, but the hope is expressed that it may be of some value to workers in research and applied branches of the subject. Its purpose is to supply an outline of important facts concerning diseases of vegetable crops in the United States; it follows that British readers may be unfamiliar with some of the crop plants and the methods used in their cultivation.

The diseases are arranged under headings of host plants or related host groups. Important diseases are treated in detail but with a brevity of style typical, and no doubt necessary, in publications of this kind. For each major disease the information supplied includes host range, history of the disease, its geographical distribution, its economic importance, the host symptoms, life-history and description of the causal organism, environmental conditions, varietal resistance (if any), and various other factors, concluding with particulars of control measures. After each disease there is a list of references to literature; these are indicated by numbers at suitable places in the text wherever relevant to the point under discussion.

Minor diseases, as might be expected, are dealt with less exhaustively, but a very large number are mentioned, the individual treatment varying from a single sentence to short paragraphs containing descriptions of symptoms and methods of control.

A feature that will be welcome to many readers is the inclusion, after each host heading, of notes on current methods of cultivation and of marketing the crop. Such knowledge of a crop is, as the author mentions in his introduction "basic to an adequate understanding of the development of its diseases and of their control". This point of view is one to be commended to English writers on the subject.

Workers in Great Britain who purchase the book will, in the main, find much that will interest them, although they may be surprised that such a well-known control practice as the mercuric bichloride treatment against club root in cabbages is not mentioned. Nor, in seeing some of our well-known diseases here listed as very minor troubles, must we forget that this publication is written primarily for American workers and in this respect fulfils its purpose in a very workman-like manner. It stresses the importance of a practical knowledge of crop requirements as an aid to dealing with disease problems, which aspect of plant pathology is somewhat neglected in training British students.

The references to literature are chiefly limited to American publications. This may be expected, but although the book is primarily intended for American readers it could, with little extra work, have been made more attractive to British plant pathologists. It can be considered a useful, but far from indispensable, addition to our reference shelves.

The text is singularly free from mistakes, but some unfortunate error in pagination has resulted in one half of the diseases in the index and three quarters of the table of contents possessing wrong page numbers. On page 65 in the index Crucifers (contnd) should read Curcurbits (contnd).

The book is more informative than a mere bibliography and despite the absence of any illustration is, at the price, good value. It is obviously meant for home consumption and a limited circulation. D. E. GREEN.

CHEMISTRY OF OSMIUM AND PLATINUM

Gmelin's Handbuch der anorganischen Chemie
Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 66: Osmium, mit einem Anhang über Ekaosmium. Pp. xx + iv + 100. 14.25 gold marks. System-Nummer 68: Platin. Teil A, Lief. 1: Geschichtliches Vorkommen. Pp. 146. 16.50 gold marks. Teil B, Lief. 1: Physikalische Eigenschaften des Metalls (bis thermische Eigenschaften). Pp. 72 + iv. 8.25 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1938–39.)

THE parts of "Gmelin's Handbuch" under notice deal with osmium and platinum. Osmium, the heaviest of all known substances, has a high melting point and is harder than glass and quartz but is scratched by topaz. Its scarcity and its tendency to form the highly poisonous, volatile, strongly smelling tetroxide prevents its commercial exploitation. It is a highly efficient catalyst, especially in hydrogenations. The tetroxide dissolves in water to give a neutral solution with an extremely small electrical conductance ratio, but it forms salts with bases. It is readily reduced to lower oxides or to the metallic state. Thus in alkaline solution its valency falls to 6, and in neutral and acid solution to 4, the dihydrate of osmium dioxide being formed; but reoxidation by oxygen is readily affected so that it is an excellent oxygen carrier. With concentrated hydrochloric acid it gives chlorine. On heating the metal in chlorine a series of intensely coloured sublimates is formed. These are difficult to separate, but at 650° C. a black tetrachloride can be obtained.

Osmium forms a large number of complex co-ordination compounds, such as potassium nitrosochloride, $K_2[OsNOCl_5]$, osmiamic acid, $H[Os\,O_3N]$, a hexacyanide, $K_4[Os(CN)_6]$, and numerous organic derivatives. Six isotopes have been described by Aston and one by A. O. Nier. Eka-osmium, element 94, is known only in the form of two artificial isotopes produced by bombardment of uranium with neutrons.

The first part of the volume on platinum deals only with historical notes on the discovery of the six metals of the group and with their geological origin and geographical distribution. Although platinum has been found in ancient Egyptian works of art, it is probable that its employment for the purpose was accidental, its identity not having been recognized. There is evidence of its use in South America before the discovery of that continent by Columbus, but it was not until the middle of the eighteenth century that it began to attract general notice. W. Watson described its properties in the *Phil. Trans.* of the Royal Society in 1749, without, however, laying claim to its discovery. Thenard first observed its catalytic properties in 1813 during his investigation of the decomposition of ammonia, and in 1817 Sir Humphry Davy described the flameless combustion of various gases in presence of the metal. Palladium was discovered by Wollaston in 1803, but his discovery was first revealed anonymously and it was not until after he had obtained another new metal, rhodium, that he revealed his identity in 1805. Iridium and osmium were both discovered in 1804 by Tenant, while ruthenium remained unknown until isolated by C. Claus in 1844.

During the segregation of minerals in the earth's crust all the members of the group except palladium have passed almost completely into the metallic phase, while palladium with some platinum and ruthenium occurs in the form of sulphide. Geological maps of the distribution of platinum-bearing minerals in the Ural Mountains are given. Before the War of 1914–18, 95 per cent of the world's supply came thence. Apart from deposits in Spain and Siberia, the minerals bearing platinum occur in three zones of mountain ranges: (1) in America between Alaska and Chile; (2) from eastern Australia through the Philippines to Japan; and (3) from the Urals through Abyssinia to Rhodesia.

The second part of the section on platinum deals exclusively with the physical properties of the metal. Five isotopes are known, and an account is given of their formation by bombardment with deuterons and neutrons as well as of the transformation of platinum nuclei into other elements. It is suggested that the protons and neutrons of the nucleus may to some extent be combined to α-particles. The crystal lattice is made up of face-centred cubes with four atoms in each cell, no polymorphism having been established.

Hydrogen is the only gas which diffuses through the metal; even after two months no trace of air has been found to diffuse into an evacuated vessel through platinum foil 0·02 mm. thick. Curves are given showing the influence of changes of temperature and pressure on the rate of diffusion of hydrogen. Diffusion is not noticeable below red heat, and since the rate is proportional to the square root of the pressure it has been suggested

that diffusion is preceded by molecular dissociation. Some difference of opinion exists as to whether hydrogen released in electrolysis at a platinum electrode penetrates the metal or not by true diffusion. As the rate of diffusion of heavy hydrogen is about three fourths of that for ordinary hydrogen, the difference is not enough to facilitate the separation of the isotopes.

THE CONQUEST OF ENERGY

Atoms in Action

The World of Creative Physics. By George Russell Harrison. Pp. x+370+16 plates. (London: George Allen and Unwin, Ltd., 1940.) 12*s*. 6*d*. net.

IT is sincerely to be hoped that no one will be misled by the title of this book. "Satan's invisible World Displayed" was not, as Herr Teufelsdröckh imagined, a history of the British Press; nor is "Atoms in Action" just another addition to the number of books which attempt to convey to a bewildered, and by now rather blasé, public the latest inside information about the structure of the atom. Of course, atoms come into it—atoms, as everyone who has ever attempted high vacuum technique knows only too well, leak in everywhere—but the operative word in the title of Prof. Harrison's book is not "Atoms" but "Action". "Almost every material problem of living," writes Prof. Harrison, "turns out in the last analysis to be a problem in the control of energy. That part of the cost of a lady's hat which does not represent business acumen on the part of the milliner is for stored and directed energy—the atoms of matter of which the hat is composed are permanent, and will still exist when the hat has been discarded and burned. Only energy and knowledge of how to apply it are needed to recreate a hat from its smoke and ashes."

Energy, its control, distribution, and utilization in modern times is the theme of the book, and a very stimulating theme it is. "Every dweller in the United States," we are reminded, "is now served, on the average, by energy equivalent to that which could be provided by thirty slaves such as sweated at the command of an ancient Egyptian king. In making this much energy available, science has contributed only a small fraction of what it can contribute. Human beings can be made twenty thousand times as wealthy as they are to-day; but only fundamental investigation of nature, such as is involved in 'atom smashing', will show how."

Prof. Harrison's main purpose in producing this book—which by the way was written at the instance of the American Institute of Physics—is neither entertainment nor instruction, though he gives his readers plenty of both. Essentially the book is a plea for research, and still more research. "Experience," he claims, "has shown no better way of eliminating poverty than by well-directed 'atom-smashing'," and in successive chapters of the book he drives home his statement by examples drawn from many branches of modern industry. He tells us, to mention but a few of the topics, of the applications of physics in farming and in medicine; of cold storage and illumination; of radio and television; and of the harnessing of the electron for electrical control: nor does he overlook such mundane, but important, matters as "profits" and "costs".

Even to a physicist who, for various reasons, has kept in fairly close touch with industrial developments of the subject, it is a thrilling story when compressed, as it is here, into a single volume; and Prof. Harrison tells it extremely well. He has a charming style, a flair for the exact phrase, an eye for illuminating and unusual comparisons, and a sly sense of humour which, without being obtrusive, gives sparkle and zest to the text. The chapters run on with the informality, the clarity, and the absence of intrusive technicalities which characterize the very best kind of talk; and at the end the reader finds that he has learned almost all he wanted to know of the subject, and (perhaps equally important) he has not been bored with things he did not want to know. In writing his progress reports, Prof. Harrison has been able to tap original sources of information (some of it unpublished) available in many of the largest research organizations in America. It may be taken that his stories are as authentic as they are interesting.

Some appreciation of the achievements of science, and the methods by which they have been reached, is nowadays an essential part of a good general education, and no better mentor has yet appeared than Prof. Harrison. In particular, it is much to be desired that "Atoms in Action" might find its way into the hands of all Cabinet Ministers, present or prospective, of heads of departments, and business directors. For, as its author reminds us, the end is not yet!

> "Still o'er the earth hastes opportunity,
> Seeking the hardy soul that seeks for her."

Much will depend in the future on our preparedness to seize the opportunity presented to us in the almost infinite possibilities of well-directed physical research. J. A. CROWTHER.

MEMOIRS OF AN IMMUNOLOGIST

As I Remember Him:
the Biography of R. S. By Hans Zinsser. Pp. x+369. (London: Macmillan and Co., Ltd., 1940.) 12*s*. 6*d*. net.

THIS book must be accounted a notable achievement when we consider that it is the parergon of one who spent a strenuous life devoted to researches in the fields of microbiology and immunology. The reader should keep clearly in mind that the author, Dr. Hans Zinsser, who was professor of these subjects in Harvard University until his recent death, adopted the fiction of narrating the events of his own life and experiences as if they had happened to "R. S.", a mythical friend. The author wrote the last chapter, which describes the thoughts of "R. S." during his fatal illness, when he himself was under the shadow of impending death. He did not use the device of anonymity in order to heighten his self-importance. On the contrary, he took pains to assure the reader that his objective counterpart was an ordinary intelligent person who was often not really competent to pronounce opinions on many of the topics that are discussed in the book. This modest attitude is stressed in the first chapter and also in the final sentence of the last chapter, which states that it seemed scarcely worth while to have written a book about his 'friend'—a view which is unlikely to be shared by its readers.

Zinsser's father migrated to the United States from the Rhineland and his mother from the region of the Black Forest. Their children were born in the New World, and the author tells us that he spoke no English until he was ten years of age. His youthful ambitions were directed towards a literary career, but the researches of Edmund B. Wilson on cell division so fascinated him that he chose biology as a subject of study and was later advised to take a medical course. He tells in an amusing fashion how an attempt to combine practice in New York with laboratory work proved unsuccessful and how he then specialized in bacteriology, lectured to students, directed the work of his research assistants, and in odd moments scribbled sonnets on scraps of paper.

In the course of time an intensive study of the mode of spread of typhus fever led him far afield: to Serbia, Mexico, Tunisia and Russia. He greatly admired France, had many French friends and thought Paris the most civilized city in the world. He makes vivid for us the romantic feelings aroused in him there as a youth of twenty-one; and he recalls memories of spring in the Luxembourg Gardens and of the rhymes of Ronsard, Villon and Verlaine ringing in his head. When he had become a noted man of science, he was appointed visiting professor at the University of Paris, where he lectured in French to the students, and his experience forms the basis of an interesting discussion on the relative merits of French, German and American universities. During the visit his friend Vallery-Radot gave him a copy of Pasteur's will, with permission to quote it in this book; the will consists of three simple sentences embodying two equally simple wishes. Readers in Great Britain can scarcely fail to remark that the author's love of France apparently left him little room for appreciating British characteristics and cultural values; perhaps he found it difficult to break down the barrier of British national reserve. However this may be, it is certain that we should have enjoyed his candid comments for, as his book abundantly shows, he was a kindly and tolerant observer of human nature. He deplored the political degradation of Germany and had looked forward in vain to its transformation into a free Republican State.

Towards the end of his life he visited Japan and China, and found in Peking a source of charm that no other city except Paris had ever held for him; he was attracted, too, by the people, a natural consequence of his friendship with many Chinese collaborators during a period of more than twenty years.

Dr. Zinsser was a versatile man with a wide range of intellectual interests, and thus he was drawn to those whose view of life was not bounded by their specialty but—in his own phrase—whose minds swept the horizon. He notes that his friend the late Dr. Charles Nicolle, for many years an expert in tropical medicine and director of the Pasteur Institute in Tunis, was novelist, philosopher and historian; and that Laennec, the inventor of the stethoscope, was an accomplished pathologist, classic, flute-player and horseman. Unlike some of the younger men of science of the present day he possessed a strong historical sense, and took pleasure in viewing modern ideas, customs and methods in the light of the past.

This book contains a wealth of reflections on a great variety of medical, educational and political subjects; and, since the author has an easy style with a talent for descriptive writing that is enlivened by humorous and ironical comments, the reader's interest is never allowed to relax.

G. F. Petrie.

THE UNIVERSITY OF ICELAND

By Pjetur Sigurdsson,
Secretary, University of Iceland

THE University of Iceland was founded on June 17, 1911, the hundredth anniversary of Mr. Jón Sigurdsson, who was a profound scholar and the nation's leader in her struggle for independence in the nineteenth century. It began its activities with four faculties, namely, theology, medicine, law and philosophy, the last-named comprising the Icelandic language, history and literature, besides philosophical studies. At first the teaching staff consisted of ten professors and a few lecturers.

Prof. Alexander Jóhannesson, Ph.D.
Vice-Chancellor, University of Iceland.

The University was at first housed in the Parliament building, but this accommodation soon proved too small and inconvenient, and for more than twenty years the University authorities fought strenuously to obtain a separate building. At last, in 1933, they obtained the sole right to establish a money lottery in Iceland, with the view of defraying the expenses of a new building, suitable for the University and in every way meeting modern demands.

The lottery commenced operations in 1934, and the University building was begun two years later and brought to completion this year, partly by borrowed money to be repaid in the course of the next few years out of the profits of the lottery. The new building was dedicated on June 17 last, and teaching began there this autumn.

The main building is about 240 ft. long and is three-storied, with a wing running out from the centre at the back. On the ground floor are the offices, the lecturers' common room, the reading-room, and the library, biological, physiological and pharmacological laboratories, and a research room for the investigation of foodstuffs.

On the second floor are nine lecture rooms, the collections and apparatus belonging to the Medical Faculty, the chapel, and the great hall.

On the third floor are fourteen workrooms for the teaching staff, while the rest of this floor will, to begin with, be placed at the disposal of other schools.

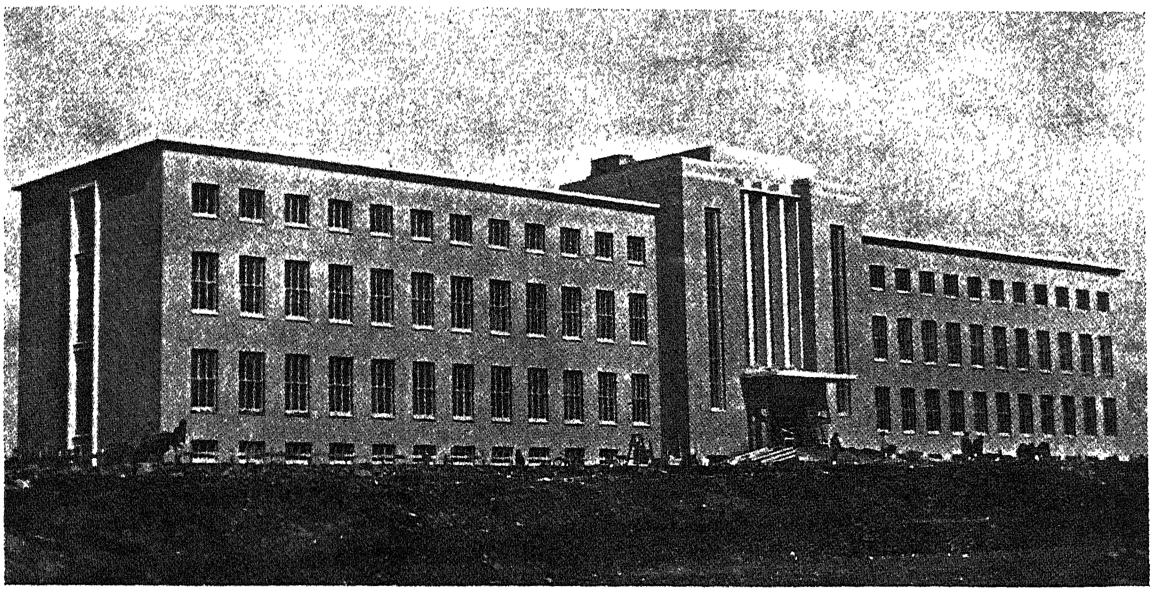
The University forms the largest building in Iceland, so far, and in more respects than one it marks an epoch in Icelandic architectural style. Most building materials have to be imported from abroad, but in the new University native material has been used to a much larger extent than heretofore and in a manner different from what has hitherto been known here. Prof. Gudjón Samúelsson, the State architect, who designed the building, also supervised its construction.

Besides this new main building, there are other buildings connected with the University; such as the Students' Hostel, built in 1934, the University Research Institute, built in 1936, both standing in the University grounds, a very large and beautifully situated plot on the outskirts of Reykjavik. There are also pathological and bacteriological laboratories housed in one building near the Landspítali (State Hospital), and built in 1934, where part of the instruction in medical science is given, while the rest is given in the State Hospital and the University building. In this building, too, researches are made into animal diseases, for, besides the old endemic ones, various other dangerous sheep diseases, hitherto unknown in this country, have come in recent years.

In the University Research Institute there are the Departments of Fisheries, Industry, and Agriculture.

The Students' Hostel can accommodate thirty-eight students. There are also a reading-room, a dining-room, and a sports room.

The University is attended by some 290 students, and its teaching staff comprises fourteen professors and as many lecturers. The principal aim of the teaching is to prepare the students for official careers in the State, for scientific work is more difficult here than at the big universities of other countries. Yet, as mentioned above, both the University and the medical research department have undertaken researches into animal diseases and done good work.



New Building of the University of Iceland.

The Philosophical Faculty lays the main stress on teaching the Icelandic language, history, literature, and old Northern lore. This Faculty will lead in all work done in the field of national learning. Though the Icelanders have preserved the old cultural treasures of Scandinavia better than any other nation, yet most of the old manuscripts in which these treasures are to be found are kept in foreign museums, particularly in Copenhagen. These MSS. were exported to Denmark at a time when Iceland was ruled from Copenhagen. But as Iceland has now become a free and independent country and only united to Denmark by a common king (a tie which the present events rent asunder early in April last) negotiations are being carried on with the view of getting the old cultural treasures, such as MSS. written by Icelanders on Icelandic and Scandinavian matters, returned to Iceland. If this can be achieved, which there is no reason to doubt, the University of Iceland will be in a position to play a still more important part in research into the old Northern lore. For doing such work the Icelanders are better equipped than other nations, because the tie between the present and the past forms of their language and literature has never been rent asunder. Every Icelander thoroughly understands the old literary works which were written some eight hundred years ago.

Though our University is small, it works in the same spirit as other universities, and with the same zeal and sincerity for the good of the nation and for the promotion of learning.

THE STUDY OF PREHISTORIC TIMES*

Though T. H. Huxley, having established beyond the reach of criticism 'Man's Place in Nature', considered that his duty as biologist and anthropologist stopped short at the limits of organic evolution, he realized, perhaps before anyone else, that the principles of evolution did not stop there. He was well aware that when a primate had made a tool and had thus become entitled to be called a man, a new vista was opened in the realm of evolution, and that by the creation of extra-corporeal organs man had discovered a new method of adjusting himself to his

* Substance of the Huxley Memorial Lecture of the Royal Anthropological Institute delivered by Harold J. E. Peake on November 26.

environment. Just as the doctrine of evolution, when applied to plants and animals, is the fundamental theme and focus of all biological research, so the evolution of civilization should hold a like place in anthropological studies, and its most important duties should be to trace, step by step, man's progress in the development of his material civilization, the evolution of his varied forms of social organizations, allied as these are with the growth of his religious conceptions and practices, until the whole series is complete from the primitive flint tool to the aeroplane or television, from the simple family group to the nation or empire. Here attention is directed to the methods that have been used and are still being employed to reconstruct man's behaviour during the period before writing was known that is termed 'prehistoric'.

Few, if any, peoples, however primitive, are not interested in their past. They have embodied it in tradition ; while other tales, related to explain natural phenomena, are embodied in myths. This body of tradition and myth, especially in the highly elaborated forms, such as are found in the Homeric poems and other great national and tribal epics, are the only available accounts of prehistoric times. Study of these records has oscillated between acceptance and sceptism ; but sufficient confirmation has accrued from such archæological investigations as those of Schliemann at Mycenæ, Sir Arthur Evans in Crete and others, to justify acceptance of legend as containing a germ of truth about the deeds of heroes and about prehistoric times.

Philological studies, beginning with the investigations of Sir William Jones on the relations of Sanskrit, Greek, Latin and German, of which the results were embodied in an address delivered in India in 1786, have, as the result of much speculation and discussion, been responsible for theories as to linguistic and racial origins and pictures of prehistoric times, which in so far as justifying the theory of a predominant Aryan race is concerned, have failed to retain a place in scientific theory.

While the Aryan theory based on linguistic evidence has thus come to be discredited, study of the physical characters of the populations of Europe, and of human remains dating from prehistoric times, has led up to the classification which took final form in the work of W. Z. Ripley (1900), who argued that Europe had been peopled by three races, the Nordic, Alpine, and Mediterranean, though the existing populations show a large number of intermediate types owing to intermixture.

In the nineteenth century another line of research was pursued in the hope of throwing light on the social and economic organization of prehistoric peoples. Studies of the village communities of Denmark by Olufsen (1821) and of the German mark by von Maurer indicated the existence of village communities with common ownership and cultivation of the soil among all Germanic, Scandinavian and Celtic peoples. Further studies of the village communities followed, beginning with those of Sir Henry Maine based upon his experience in India. In Britain, Seebohm's view of the pre-Saxon origin of the village community has recently been revived, with additions by Peake in the suggestion that the three-field system may have reached Britain from the Danube basin about 1200 B.C., while it is suggested that both the 'Celtic' rectangular enclosure first identified by Crawford from the air and the 'long strip' system may characterize distinctions marked between the central European populations in the Middle Bronze Age, and possibly represented in successive migrations into Britain in the beginning of the Late Bronze Age, which brought two distinct types of cultivation with them.

So far, except for a number of skeletons with reliable associations, none of the evidence upon which these methods of inquiry depend is of prehistoric date. The only science which has at its disposal an almost endless supply of contemporary documents coming down to us from prehistoric times is archæology—and this, too, is strictly limited to material culture.

It is only within the last few generations that archæology has attained to sufficient precision in its methods to be worthy of being called a science. The study has passed through many phases ; and it may not be valueless to trace the succession of ideas that has marked its progress.

In very early days, men noticed ancient monuments which they attributed to their legendary heroes, as did Pausanias at Tiryns and Mycenæ. Hesiod realized there had been a bronze age before the age of iron ; but Lucretius was the first to make a clear statement on the matter ; the belief, however, that stone, and perhaps copper and bronze, implements were thunderbolts was widespread. The study of legendary material in the Middle Ages, of which the work of Geoffrey of Monmouth is a conspicuous example, continued until towards the end of the sixteenth century, when Camden in his "Britannia" started a new scientific method by interpreting ancient monuments in the light of statements made by classical writers.

The first to appreciate the true significance of stone implements was Michaelis Mercatus (*ob. c.* 1590), who made a definite pronouncement that they were made by men before they knew how to use metal, and Dugdale also, in 1656, attributed polished flints found at Oldbury in Warwickshire to men ignorant of the working of iron or brass.

Prehistoric questions aroused considerable interest in Great Britain, though early remains were usually attributed to the ancient Britons or the Druids. In the meantime, the work of a commission appointed to investigate the history of Denmark in 1806 led C. J. Thomsen, after studies extending over twenty years, to divide prehistoric times into three phases: the ages of stone, bronze and iron.

In France the work of Boucher de Perthes in the Somme valley, first published in 1838, led in 1859 to the acceptance by British geologists and archæologists of the Abbeville implements, as pointing to the existence of man here "at a period remote beyond any at which we have hitherto found them", while it was made clear from these discoveries that the Stone Age must be divided into two, as Lubbock suggested, namely the Palæolithic and Neolithic Ages.

The discrimination between cave and drift implements in the Palæolithic period initiated a series of classificatory systems which culminated in 1912, when Breuil added the Aurignacian to those familiar phases of Chellean, Acheulean, Solutrean and Magdalenian. For a time, this sequence was considered final; but discrepancies have since necessitated some revision.

The discovery of the Swiss pile-dwellings in 1853 led to the conclusion first formulated by Keller that the neolithic civilization and domesticated animals were first introduced from Asia about 5000–4000 B.C. The attempt to fill in the gap believed by some to exist between palæolithic and neolithic led to the investigation of the Danish shell-mounds by a committee appointed in 1860, the identification of the Tardenoisian and Azilian cultures, and finally in 1921 to the recognition by R. A. S. Macalister that this so-called gap covered cultures which he grouped together as "Mesolithic".

Thus between 1836, when Thomsen recognized the three ages of stone, bronze, and iron, and 1921, archæologists had framed a system of relative chronology extending from Harrison's Eolithic, the earliest period, down to the close of prehistoric times. How such a relative chronology became converted into a positive chronology, at any rate for the later phase, may now claim attention.

Excavation of archæological sites, the examination of monuments and the decipherment of inscriptions, supplemented by tradition embodied in written documents, in Egypt, Mesopotamia and Greek lands, made possible correlations to which Crete and Egypt contributed largely, and upon which it became possible to work out a chronological system making a framework for archæological discovery extending from the fourth millennium B.C. or earlier, down to historic times.

The diversion of interest in archæological excavation from buildings, objects of art, and inscriptions, to which it had been directed in the nineteenth century, to the lesser finds, and especially pottery and sherds, opened the way to the study of cultural complexes and their distribution. This led up, through the work of Ratzel, Graebner, Rivers and others, to the more extravagant theories of the Diffusionist school, which traced the origins of all cultural development back to ancient Egypt. For a time, a violent reaction against such extreme views precluded advance along these lines; but a saner perspective in more recent work, accepting the principle, and tracing the diffusion of culture elements from the Aegean area, has laid the foundations of a chronology for the greater part of central, northern and western Europe, with a margin of error of rarely more than a century, from the middle of the fourth millennium B.C. The chronology of the pre-agricultural stage is still uncertain, but hopes are entertained that this may in time be reduced to some semblance of accuracy by studies and methods which collectively may be called geochronology.

Among pitfalls to which the archæologists of the past have been prone, and to which we ourselves are still inclined, is a too rigid adherence to such classificatory distinctions as palæolithic, mesolithic, neolithic and the like, which, while convenient enough for the purposes of the museum curator, do not represent the actual conditions of life in prehistoric times, when these periods and cultures were not marked off from one another with such extreme precision. These arbitrary divisions cut across many vital distinctions. The difference between Lower and Middle Palæolithic has disappeared; while the first great break in continuity occurred, it is believed, early in Aurignacian times with the arrival of *Homo sapiens* in Europe. The next great break occurred with the cultivation of grain and the taming of wild animals, indicating the neolithic age and making settled life a possibility.

When we consider the long duration of the mesolithic age and the still greater length of time occupied by the various phases of the palæolithic, it seems unnecessary to divide into a number of comparable ages the period during which crops have been cultivated, namely, a period of little more than 7,000 years. Most archæologists are coming to the conclusion that the stages in metallurgy do not form the most convenient divisions for the grain-growing age. It has long been clear that in Britain the Middle Bronze Age, when successive waves of invaders from central Europe forced themselves into the country, a movement also apparent all over Europe, caused a greater

break in the continuity of culture than the various advances in metallurgy. In a recent work, Hawkes has suggested that the first period of the development of culture in Europe closed with the fall of the Palace of Knossos. A second grain-growing period may conveniently be regarded as ending with the coming of the Romans. There is much, however, to be said for the suggestion that prehistoric times came to an end with the introduction of Christianity and written documents, or even continued to the middle of the eleventh century.

These changes, omissions, and additions in the recent development of prehistoric studies require a revision of nomenclature which might as a starting-point be based upon the distinction marked by Elliot Smith between Palæanthropic and Neanthropic man. While the former epoch is at present in a state of flux which precludes further subdivision, the latter falls naturally into two phases: the hunting and collecting age, and the second a cultivating age or the corn age, which is in turn divisible into four main periods. The first is conspicuous for the spread of cultivation, the second was a period of invasions, the third, the medieval period or age of faith, and the last the modern period or the machine age.

Stratigraphy, typology, the study of the distribution of cultural elements, more especially with the aid of distribution maps, each by its appropriate method and argument, has made and will continue to make specific contributions to prehistoric studies.

In the past, archæologists were wont to focus their attention on flints, potsherds or works of art —always on material objects, regardless of the men who made them. Younger investigators, and some of the veterans too, are now realizing that the human element is all-important. We are engaged in fitting together a gigantic jig-saw puzzle, of which many of the pieces are missing. To solve this gigantic puzzle—not one puzzle only, but a series—a picture of each succeeding age is needed, and ultimately an absolutely continuous series, like a roll of film, giving a moving picture of the progress of mankind. Then, if even only a part of our considerable task has been performed, we shall be in a better position to achieve that new orientation in world affairs for which many of the greatest thinkers of to-day are striving.

THE CENTRAL REGISTER

READERS of NATURE will recall several references during the past year or so to the work of the Central Register set up by the Ministry of Labour and National Service. A survey of the position of the Register as a whole appeared in NATURE of February 3, 1940, p. 176.

The Central Register has now been working for more than a year, and up to the end of October had made 9,016 placings of persons from the Register in Government Departments and other organizations engaged on work of national importance. The number of placings of scientific men of all kinds, including industrial chemists but not engineers, is 1,469.

In June last, the Select Committee on National Expenditure examined the Central Register and issued a report upon it. The report emphasized that the Central Register was an essential part of the organization of the national effort and was not, as was often supposed, an employment-finding agency; its function, as the Committee expressed it, was not to find jobs for men but to find men for jobs. The Committee noted that the chief use of the Register had been by Government departments and such bodies as Chatham House and the British Council, and that little use had been made of the Register by industry. The Committee recommended, therefore, that steps should be taken to encourage employers in the vital war industries to make greater use of the Register. The Committee referred to a widespread belief that Government Departments had not followed the Government's declared policy that the Central Register should normally be the sole medium for the recruitment of temporary staff of the standard of the Central Register. It declared that this belief was mistaken, and that departments in general had used the Central Register, exceptions to the rule being confined to the most part to the earlier stages of the War.

At the same time, the Committee expressed strongly its conviction that the position of the Central Register as the sole agent for recruiting higher personnel to Government Departments should be fully maintained, except where the urgency of any requirement of special qualifications justified an exception to the rule. The Committee further examined the criticism that there was delay in filling appointments through the Central Register, and stated in its report that this criticism had been examined and found unjustified. Some orders had been filled within a few hours, while the average time taken by the Register in making submission was between

six and eight days. This period included, generally, consultation with the appropriate panel and inquiring whether the volunteer was available and willing to be considered for the post in question and whether his existing employer had any observations to offer. The Committee stated that it had visited the Register and was of the opinion that the present staff should be adequate to cope with the much greater use of the then 97,000 names on the Register which it desired. The Committee also placed on record the appreciation of the amount of voluntary effort which leading members of the professions had given to the Central Register.

Shortly after the report of the Parliamentary Economy Committee had been published, steps were taken for the compulsory registration of certain categories of persons on the Central Register where the demand was considerable. The Specified Classes of Persons (Registration) Order required qualified engineers, engineering scientists, chemists and physicists to enrol with the Central Register if they had not already done so. The result of this compulsory registration order has been to bring the total of names on the Central Register to nearly 200,000. The number of chemists who were registered as a result of the compulsory order was 5,954, the number of physicists 1,175, and the number of engineering scientists 226. These numbers are, of course, additional to those already enrolled on the Register.

Of special interest is the re-organization of the Central Register Branch which took place about this time under the control of Mr. O. V. Guy, who has been temporarily seconded from the Cambridge University Appointments Board to become an Assistant Secretary at the Ministry of Labour and National Service. The increase in the pace of the war effort, the wide powers given to the Minister of Labour and National Service under the Emergency Powers Act, and the compulsory registration of persons with technical qualifications referred to above had put additional responsibilities on the Central Register, and it was thought desirable to secure a greater understanding of the demands of the ordering Departments on one hand, and on the other hand to have a greater degree of specialization in the work of selecting candidates and handling problems of the best utilization of people on the Register. With this in mind a number of qualified scientific and technical officers were added to the staff of the Central Register. It was further thought necessary to bring the Register into closer relation with the general employment policy of the Ministry.

As a result of these considerations the Central Register was attached to the Employment Department of the Ministry of Labour and National Service, and arrangements were made for Mr. Guy to attend regularly the sittings of the Labour Supply Board. The Register was divided into seven sections, two non-technical and five technical sections. The five technical sections were placed in the charge of qualified technical men as follows: civil engineers, architects and surveyors under Mr. G. E. Forward (recently on the staff of Messrs. Howard Humphreys and Sons); mechanical engineers under Mr. J. C. Orkney (seconded from his post as lecturer in engineering at the University of Aberdeen); electrical engineers under Mr. A. L. Fielding (seconded from the post of advisory and inspecting engineer with the Agent General for the Government of New South Wales); chemists, industrial and pure, under Prof. W. Wardlaw (seconded from his post as professor of physical chemistry at Birkbeck College); all other scientific workers, including mathematicians, under Dr. C. P. Snow, fellow and tutor of Christ's College, Cambridge). Among the duties of Dr. Snow will be that of examining means of utilizing on branches of scientific work in which war-time demands are great, the services of men whose secondary rather than their primary qualification fits them for such work. Thus a number of biologists have been appointed recently to posts making use of their aptitude for physics. The seven sections are co-ordinated by Mr. H. R. Whiteman, a deputy divisional controller of the Ministry, who has been transferred to the Central Register to replace Mr. F. Gent on his retirement.

The new organization has already shown an improvement on the old. The technical heads of sections make better contact with the Service and Supply Departments from their more intimate knowledge of the problems at issue. This allows orders to be handled with a greater understanding than before. Meantime, the advisory machinery has continued to operate fully, and questions concerning the age of reservation, and supply and demand of qualified technical people of all kinds have come before the committees.

It is worth noting also that, of the members of the Scientific Advisory Committee under the chairmanship of Lord Hankey, all but one are members of the advisory machinery of the Central Register. This arrangement will avoid any overlapping of function between Lord Hankey's Committee and the Central Register, and enable the problem of supplying the requisite personnel for research to be closely linked with the development of research, and with the problems of the application of science to the war effort which Lord Hankey's Committee is considering.

In conclusion, it may be of interest to refer to the Central Register of Aliens, which at present contains 3,400 names of qualified professional men

such as engineers, many of whom are immediately suitable for employment. In connexion with the steps being taken by the Government to secure that use is made where possible of the services of friendly disposed aliens in the prosecution of the War, Mr. Bevin set up an International Labour Branch to co-ordinate questions of the employment of aliens. The Central Register of Aliens has accordingly been transferred from the Central Register to the International Labour Branch, where in common with other problems of the employment of aliens it will be in the charge of Mr. T. T. Scott, late of the International Labour Office at Geneva. Prof. J. A. Davies, of King's College, University of London, has joined the International Labour Branch as a technical officer appointed to assist in finding ways for the utilization of the services of aliens.

Security restrictions have so far hampered the placing of friendly aliens in employment, but with the increasing demands of war industry, and the encouragement by the Government of the employment of approved aliens, a wider use of this Register can be expected.

KINETICS OF CONTACT CATALYSTS AND THE INDUSTRIAL BACKGROUND*

By Prof. Hugh Stott Taylor, F.R.S.,
Princeton University

It is a tragedy of the efforts of the student of chemical reactions at surfaces, in these closing decades of the two centuries of service to culture and civilization that the University of Pennsylvania is now celebrating, that the finest flowers of the effort should have synchronized with, and been made subservient to, the international tragedy of 1914–1918 and that which now burdens the human race. It was not mere accident that, in the decade preceding the first Great War, out of the fundamental researches of Sabatier on the capacity of nickel and other metals to induce the combination of hydrogen with unsaturated substances, there emerged the answer to the famous query of Napoleon to Frenchmen of science one hundred years earlier as to the possibility, in a blockaded country, of converting liquid fats into the solid fats necessary for the production of margarine and of soaps. It was a proud boast of an English technician in 1919 that success had been attained in converting fifth-grade whale oil into edible fats in the last years of the first World War. It cannot be chance alone that the industrialization of Haber's researches on the fixation of atmospheric nitrogen and the production of the ammonia necessary for fertilizers and explosives should have been achieved on the eve of that same war which found Germany cut off, by British sea-power, from the only hitherto available source of fixed nitrogen, the nitrate deposits of Chile. These processes demanded in their turn cheaper sources of hydrogen. This was achieved by new processes of formation at catalytic surfaces, and put to use for the filling of those now archaic 'sausage balloons' that served as observation posts in the battle lines of Flanders. To-day the hydrogen is used in 'barrage balloons' employed in defence against the attacks of invading bombers.

Two decades of 'progress' demanded the solution of new problems for the coming new war. The mechanization of transport has profoundly modified the technique of modern warfare. The present distribution of sea-power compelled a blockaded country to ensure for herself either accessibility to the necessary raw materials of transport such as oil and rubber, or alternatively so to shape her technical development as to ensure the production of such materials synthetically from raw materials available within the blockaded area. Within Germany during the last years there have been developed, by means of reactions at surfaces, methods of converting coal into high-quality aviation gasoline and synthetic rubber materials which have gone far towards making that country independent of supplies from abroad. Similarly, her need for fats, mitigated in part by her conquests of the present year, demanded the replacement of the fats used in soap manufacture by synthetic detergents and the development of methods for the conversion of available raw materials into synthetic fatty acids. Marked progress has been achieved in these directions.

Even in the case of countries open to the available resources of Nature, it has been found that Nature does not always produce the most highly desirable forms of the materials to be consumed. Petroleum supplies an excellent example of such a situation. In the early days of the automobile,

* A paper at a symposium on "Chemical Kinetics" delivered on September 17 during the Bicentennial Conference of the University of Pennsylvania.

adequate fuels could be obtained by simple distillation of crude oil. Improvements were demanded by increasing fuel requirements, which led to the development of cracking processes for increasing gasoline fraction from a given barrel crude. The demand for increased power in the automobile, stimulated further by progress in aviation, led to the realization that certain types of gasoline molecules, notably *iso*-octane, possess fuel characteristics that far exceed those of other molecules within the range of volatility demanded by the engines in question. New problems were thus presented to the chemist; the conversion of low-grade natural products into the more valuable high-grade fuels. In the solution of these problems the catalytic chemist has made notable contributions. Catalytic methods have been developed for cracking complex petroleum molecules into simpler high-grade automobile and aviation fuels, for polymerizing or putting together the simpler hydrocarbon molecules to form molecules of high anti-knock value in the gasoline range, for adding simpler saturated molecules to unsaturated molecules to form valuable fuels, the so-called processes of catalytic alkylation; catalytic isomerization, the changing of molecules of a given configuration to other configurations more powerful in fuel characteristics; catalytic dehydrogenation, which coupled with catalytic processes of ring formation, led to the formation of aromatic fuels containing benzene, toluene and xylene. As a by-product of these latter new processes of dehydro-aromatization the petroleum industry is becoming an active competitor of the by-product coke-oven industry upon which, hitherto, we have been dependent entirely for the raw materials of the dyestuff industry, explosives and many pharmaceutical preparations.

Paralleling in intensity these developments with the more complex units of petroleum raw materials, a series of efforts has evaluated the lighter constituents of petroleum, natural gas and the cracked gases of refinery operations. Catalytic processes have been developed for the direct oxidation of ethylene at metal surfaces, notably silver surfaces, to yield ethylene oxide, itself a reagent of great value in a series of synthetic processes and the intermediate in the production of ethylene glycol, a product now required on a tonnage basis for anti-freeze solutions. Propylene, the next higher unsaturated olefinic hydrocarbon, is, by reason of a newly developed process, the raw material for synthetic production of glycerine available at any moment when the by-product glycerine of soap manufacture becomes inadequate to meet the demands. Butene, a four-carbon atom olefine, yields by further catalytic removal of hydrogen the butadiene which is the starting material for the synthetic rubbers of the 'Buna'-types developed in Germany. There, due to lack of petroleum, coal is the raw material and the production of butadiene occurs via the formation of calcium carbide and acetylene. That butadiene, under the influence of metallic sodium, would polymerize to a rubber-like material has been known since the end of the last century. It was such materials which were employed as rubber substitutes by the Germans in the latter phases of the War of 1914–18.

The progress achieved in the recent researches on these materials arises from the discovery that 'cross-polymerization', the introduction of other molecules into the growing unit, rubber, like the plastics, cellulose, starch, etc., is 'macro-molecular', that is, composed of large numbers of constituent units combined with each other into a structural pattern conferring on the mass its particular characteristics. The newer synthetic rubbers build into the growing butadiene polymer such other materials as styrene and acrylic nitrile, with the result that products having abrasion characteristics and resistance to oxidation, and therefore to deterioration, from 5 to 30 per cent better than the best natural rubbers have been produced. Superior characteristics over the natural products also obtain in the case of such special products as 'neo-rene' and 'thiokol' which, in addition to their carbon and hydrogen constituents, contain also chlorine and sulphur respectively, thus deviating markedly in constitution from the natural product, and possessing properties which for certain purposes render them more valuable than the natural product.

In the field of plastics also the chemistry of reactions at surfaces is making notable contributions. These materials have almost endless uses and possibilities, alike for peace-time and war. They can be used as substitutes for metals and for glass. Optical instruments, aeroplane parts, possibly even as impregnating material for plywood aeroplane wings, are among their immediate uses in the era of defence now upon the United States. Solvents for plastics, ethers, alcohols and esters are allied materials that the catalytic chemist is contributing. From these researches also come the newer synthetic fibres of which 'nylon', as a material superior in many characteristics to silk, is now in large-scale production. The raw materials from which they are made, coal, limestone, petroleum, water and air, require the chemistry of reactions at surfaces for the transformations that ultimately yield the desired products.

Side by side with the intensive industrial developments here outlined, there has grown up also in industrial research, Government and

university laboratories a broad programme of theoretical study in this field. Upon the pioneering investigations of Langmuir has been built a body of theoretical fundamental knowledge, the major contributions to which have come from American laboratories, and with the aid of which a more rapid and certain approach to the solution of problems of industry can be achieved. Langmuir recognized that the seat of chemical change at surfaces was a layer of absorbed gas one molecule thick associated with the surface by chemical forces. The heterogeneity of catalytic surfaces was then recognized and its importance in the interpretation of the great sensitivity of surfaces to poisons became understood. This concept led also to an understanding of the phenomenon of promoter action, whereby with suitable added material the efficiency of a given quantity of catalyst material could be enormously enhanced. The quantitative extent of the surface could be increased and its quality multiplied. Later researches revealed that two types of association of a gas with a surface, one physical and the other chemical, could obtain, and that the operating temperatures determined which type of interaction occurred. With different surfaces, different temperature ranges could be employed. The range of catalytic materials and the temperature ranges in which they operate were correspondingly expanded. With the advent of isotope separations, signalized by Urey's discovery of heavy hydrogen, followed by heavy oxygen, carbon, nitrogen and sulphur, new tools became available for the study of the associations with surfaces involved in catalytic changes.

To-day the analysis is going yet deeper. With the modern tools of X-ray and electron diffraction, the catalytic chemist is examining the activities of individual faces of crystals and is demonstrating that the geometrical configurations characteristic of particular faces are more favourable to the activation of reactants than are other faces. As a consequence, methods can be developed to produce the desired crystal faces in preponderant amount. Twenty-five years ago, the science of catalysis was almost purely empirical, dependent entirely on trial and error; it has now become a highly refined scientific study, rich in possibilities for applied science and in joyous endeavour for the fundamental scientist.

OBITUARY

Prof. H. Rosenberg

PROF. H. ROSENBERG, director of the University Observatory at Istanbul, Turkey, whose death has just been announced, was one of the pioneer workers in modern astrophysics.

It was in 1914 that Rosenberg completed a fundamental paper on the photographic investigation of the intensity distribution in star spectra. Using Planck's law, and for calibration the standard star α Aquilæ and the sun, he was led to a preliminary series of seventy stellar temperatures; it was the first of its kind, as previous temperature work by Wilsing–Scheiner–Muench was carried out exclusively by visual spectrophotometry. The comparative study of the differences between these two series later gave rise to a number of fruitful investigations concerning the deviations of stellar radiations from black body radiation.

In August 1913 Rosenberg announced at the Hamburg meeting of the Astronomische Gesellschaft the successful introduction of the potassium photocell into stellar photometry. At the same time as Rosenberg, but independently, work along similar lines was carried out by P. Guthnick, while the selenium cell has been used most skilfully by J. Stebbins in America. In view of the prominent part which both spectrophotometry and photo-electric photometry play in modern researches, Rosenberg's influence will not be under-estimated, even without going into detail of all his other notable contributions to astronomy. These were concerned mainly with variable stars, the formation of photographic star images, the scale of effective wave-lengths, the removal of instrumental errors; furthermore, the successful construction of a new polarization photometer and its application to surface brightness measurements on the moon (1921), of an electro-microphotometer (1925), and of a photographic double filter giving simultaneously two close star images, in blue and yellow (1936).

Most of his earlier work was carried out by Rosenberg at his private observatory at Oesterberg near the University of Tübingen, where he held a chair before his appointment, in 1925, as director of the Kiel Observatory, in succession to P. Harzer. When the Nazi regime commenced, Rosenberg was forced for 'racial reasons' to resign; he worked for two years in the United States under Prof. Otto Struve at the Yerkes Observatory at Williams Bay, and three years ago became the new director of the Observatory at Istanbul, succeeding Prof. E. F. Freundlich. The breakdown of scientific culture in Nazi-Germany prevented him from completing some of his plans; one of these has already been discussed by the present writer in NATURE (142, 496; 1938); it was the planning of a new astrophysical handbook which, in 1938 (after Rosenberg's departure but mainly with the team of his selected collaborators) was edited in a masterly way by Prof. Bengt Strömgren of Copenhagen.

NEWS AND VIEWS

Dr. F. M. Lea

THE administrators of the Beilby Memorial Fund have announced an award of a hundred guineas to Dr. Frederick Measham Lea in recognition of his researches on the constitution of silicate systems and the chemistry of cement in its physico-chemical aspects. Dr. Lea was educated at King Edward VI School, Birmingham, and after war service during 1918–19, entered the University of Birmingham, where he gained the Frankland Prize for practical chemistry, and graduated B.Sc. with first class honours in 1921, proceeding to M.Sc. in 1922 and D.Sc. in 1935. He was elected an associate of the Institute of Chemistry in 1922 and a fellow in 1936. During 1922–25, Dr. Lea was attached to the Admiralty Engineering Laboratory. Since 1925, except during 1928–29 when he was guest research associate at the Bureau of Standards, Washington, he has been a member of the staff of the Building Research Station, Department of Scientific and Industrial Research, where he now holds the position of principal scientific officer. Dr. Lea was a member of the Official British Delegation to the World Power Conference and Second International Congress on Large Dams held at Washington in 1936 and has also been a British representative on the International Committee on Special Cements, and honorary secretary of the corresponding British Committee. He has also served on a number of sub-committees of the Research Committee of the Institution of Civil Engineers and is at the present time chairman of the Roads and Building Materials Group of the Society of Chemical Industry.

Total War and Spiritual Values

As winter draws on, the 'New Order' of the Nazi régime relentlessly imposes upon the subjugated peoples of Europe conditions comparable only with those of the Middle Ages, when the peasantry had famine and pestilence ever imminent at their doors, following in the train of the wars waged by their overlords. The aims and methods of the Nazis are a grim commentary on the glorious renaissance in arts, science and letters which in Germany followed the close of the Napoleonic Wars, when a united and freedom-loving German people had helped to throw off the yoke of another dictator. Whatever may be the loss of life and property inflicted by recent activities of the Nazi air arm, nothing so clearly reveals the intention with which the Nazis have entered upon this War as the gutted Bristol Museum and shattered great hall of the University of Bristol, or the ruins of St. Michael's, the great cathedral church which for centuries has been the centre and a symbol of the corporate life of the city of Coventry. In destroying these and other edifices of a like character throughout Britain, their aim is not to secure military or material advantage, but to strike a deliberate blow at vital sources of spiritual and intellectual freedom.

That acts such as those mentioned above have their place in settled policy and are not the random and inevitable consequences of warfare from the air is made clearer as the concomitants of the political and economic 'New Order' are disclosed. Since the establishment of the customs and monetary union between the Reich and the Protectorates of Bohemia and Moravia, it is reported in *The Times*, persecution of the Czechs has been intensified. Nearly four hundred Catholic priests have been arrested, while the dismissal of the rectors and deans of the Czech universities is, not unreasonably, taken as an indication that it is not intended to reopen these institutions, which last year were ordered to close for a period of three years. The purpose of this action was indeed revealed by the Secretary of State, K. H. Frank, who when asked by a deputation to reopen the universities, replied that in the event of a German victory "elementary schools will be enough for you". The intention of completely subordinating all intellectual activity to the expression of views officially approved is even more nakedly exposed in the exhortations addressed to Czech authors to support the 'New Order' and to earn handsome royalties. They are, it is said, free to write what they will, so long as they undertake not to offend Germany. In like manner in Holland, all text-books containing any criticism of Germany are suppressed ; and now the universities themselves are threatened with closures on account of the attitude of their students.

Malayan Nature Society and Journal

A MALAYAN Nature Society has recently been inaugurated. Although the calling of an opening general meeting was found impracticable, officers have already been elected, in order to secure the inception of the Society. They are : *President*, Mr. E. O. Shebbeare, Game Department, Kuala Lumpur ; *Secretary and Treasurer*, Mr. A. T. Edgar, Suffolk Estate, Sitiawan, Perak ; *Editor*, Mrs. G. Le Mare, 254 Upper Stephens Road, Taiping. There is a number of keen naturalists in Malaya, and these should form a sound nucleus for the Society, which will doubtless do much towards promoting the study of the natural history of such a rich area and encouraging new arrivals to Malaya. The Society hopes later to inaugurate informal State or Settlement branches—a sound scheme in an area where natural history, anthropology and ethnology, etc., offer such diverse fields of study and observation.

The first number of the *Malayan Nature Journal* (1, No. 1, 1–27 ; August 1940) has just reached us. It is well printed on good paper, and attractively illustrated by three full-page, twenty-two half-page, and six quarter-page photographs. An article by E. J. H. Berwick on the long-tailed tailor-bird contains some beautiful illustrations of the male and female and of their uncommon type of nest. In the same paper is described an unusual shama's nest. Observations from a 'hide' are described and details of the structure of

the nest are given. R. O. Noone describes caves and some cave formations, and submits eight photographs of unusual interest, especially one of strange calcite growths which are even now not satisfactorily explained. The president, E. O. Shebbeare, gives a short but interesting account of an elephant trek. In a paper on Malayan bears, A. H. Fetherstonhaugh describes chiefly two bears in captivity. The illustrations of these are particularly fascinating. A few observations are also made on bears in their native jungles. G. S. Ogilvie presents a descriptive account of the 'Che Wong', a little-known primitive tribe from an area well known for its diversity of primitive peoples. This account is also supported by well-produced photographs. The *Journal* has certainly made a good start, and we wish it success and much support. The annual subscription is six dollars (single numbers, two dollars). A few spare copies of the first number are available at Malaya House (Mr. G. E. Cator), 57 Trafalgar Square, London, W.C.2.

Dried Onions

THE trade in dried onions developed after the War of 1914–18, and there is now a big demand for this material on the Continent (*Bull. Imp. Inst.*, 38, No. 3; 1940). In Great Britain the quantity used in 1939 was only about 400 tons, but in view of the scarcity of the fresh vegetable an increase may be expected. Hitherto, supplies to Great Britain have come from southern Europe; but as these are no longer available it is suggested that Empire sources be developed. The method of preparing the onions is briefly as follows: The bulbs are peeled by hand and cut into thin slices which may then be immersed in a 5 per cent salt solution for 3–5 minutes to prevent discoloration. Drying is carried out on trays in tunnel driers for about 5–10 hours, the slices being kept turned to hasten the process. The temperature should not be allowed to rise above 140° F., or flavour is lost and the slices darken.

The finished material should be dry and crisp with a moisture content of 5–7 per cent. Sun drying is said to give less satisfactory results than artificial drying. The dried product is usually shipped in tin-lined cases of 1 or 2 cwt. each, the material fetching between 65–70 shillings per cwt. before the War, but by August 1940 it was worth 150 shillings per cwt. in London. On an average, one ton of the dried material represents about 10 tons of fresh onions. The Imperial Institute, London, would be glad to receive samples of dried onions from Empire sources with the view of submitting them to the trade for a report on their market possibilities.

Mineral Products of the British Empire and U.S.A.

THE possibility of a joint control of essential minerals and other natural products by the United States and the British Empire as a means of preventing future wars or of curtailing their duration is raised again by Dr. William Cullen in a paper contributed to *Chemistry and Industry* of November 30. Dr. Cullen suggests that the great distance which public opinion in the United States and elsewhere has travelled in the past few months brings a mineral sanction within the bounds of possibility. He points out that apart from food the two most essential materials in modern warfare are steel and oil. Good steel cannot be made without manganese, and in all Europe there is no appreciable amount of manganese. Even with Poland and Rumania, Europe is very badly off for mineral oil. The United States of America and the British Commonwealth control 75 per cent of the world's reserves of economic minerals, and if the United States and the British agreed by treaty that no aggressor nation should be supplied with essential metals and minerals, and that during peace, steps should be taken to prevent the accumulation of reserves by any other nation, it would be impossible for any aggressors to carry on a war for any lengthened period. With the pronounced change in American opinion, Sir Thomas Holland may see the fruition of all his labours in this field.

New World Populations and the Future

IN another column of this issue of NATURE (see p. 783), certain figures are extracted from a comparative study by Prof. Raymond Pearl of the populations of the New World and the Old. After making allowance for any inaccuracies and uncertainties in the data upon which his study is based, he arrives at the conclusion that, when they are examined in respect of certain criteria, such as density of population in a given unit of space, rate of growth, age distribution and the like, the populations of the New World, as contrasted with those of the Old, have in a biological sense all the characteristics of a young and vigorous organism, and that this fact carries with it certain social and psychological implications. Thus he points out that the relatively low figure for the density of population implies freedom of movement and expansion in settlement, the vigour indicated by the rate of increase of population and a higher birth-rate affords freer play for the forces of natural selection and the production of a virile and healthy stock, while the higher proportion of the population of pre-reproductive age holds out promise of a bold and enterprising outlook as against the pessimistic and despondent attitude of mind in a community such as that of the Old World, in which no less than one fifth of the whole has passed the active age of production.

Taken on the basis of an abstraction, Prof. Pearl's analysis is impressive; but it has the weakness of all abstractions that it presents only a certain aspect, or certain aspects of reality. This he admits when he feels constrained to pass by the criterion of 'quality', on the ground that it is difficult or impossible to apply with scientific accuracy. He finds that quality, however, as the eugenist would maintain, does open the way in one direction at least in which Old World populations may seek to redress the balance against them. Prof. Pearl himself, indeed, directs attention to certain dangers in the future of the post-War world to which his figures point as arising out of the very advantages which America enjoys. While,

he holds, the populations of the western hemisphere are in a relatively much more favourable position biologically and demographically than are those of the eastern hemisphere, the close of the War will bring such pressure on the Americans to take in migrants as has never before been exerted. Their countries will be asked to share those acres that are still so sparsely populated. Before that happens, Prof. Pearl maintains that sound population policies scientifically conceived and administered, "should determine the relationship . . . between the numbers of the people and the area of the good earth on which they live, upon which prosperity and happiness finally depend". On the assumption that Prof. Pearl's forecast will be justified by the event, the question is one upon which the decision of the people of America, as most intimately and vitally concerned, will be final; but the problem opens up a vast field for joint investigation and effective co-operation for the general good of mankind between the peoples of the Old World and the New.

Sir Theodore Turquet de Mayerne

IN a richly documented paper (*Proc. Huguenot Soc. Lond.*, **16**, 301; 1940) on Sir Theodore Turquet de Mayerne, royal physician and writer, Miss Irene Scoloudi states that he was born at Geneva on September 28, 1573. He received his medical education at Heidelberg and Montpellier, where he studied under Riverius, who became physician to the Court of Henri IV, and qualified in 1596. He afterwards moved to Paris, where he soon became well known. In 1600 he was appointed district physician of Paris and physician in ordinary to Henri IV. Six years later he was invited to England, where he received the honorary degree of M.D. from the University of Oxford and was made physician to the wife of James I. In 1616 he was elected fellow of the Royal College of Physicians, and next year played a part in the formation of the Society of Apothecaries. In 1618 he was deputed by the College to write the dedication of the first Pharmacopœia to the King, by whom he was knighted in 1624. Although in his official capacity or as a medical witness he was connected with several scandals and lawsuits, such as the Overbury and Gaultier cases, he came out unscathed. He died on March 22, 1655. Mayerne is now chiefly remembered for his case reports by which he founded the practice of careful case taking. He published only two works composed entirely by himself, one being a pamphlet in reply to the French physicians with whom he quarrelled, and the other on a tour in France, Germany, Italy and Spain, which was one of the first extant French itineraries, and passed through several editions. In collaboration with Moffett he brought out a work on insects and also helped to compile a book of recipes for the Distillers' Company.

Public Health in India

ACCORDING to the annual report for 1939 of the Public Health Commission in India, the outstanding feature in that year was the large decrease in the incidence of cholera. Whereas in 1938 deaths from the disease in the Punjab numbered 5,670, in 1939 they were only 19. Improved sanitation of the villages and towns through which pilgrims pass is the most effective method of prevention, but is a slow process, and in the meantime the best practical method is anti-cholera inoculation, its compulsory enforcement being the best practical measure. Of the annual six million deaths in India a fifth or a quarter is attributed to malaria, to outbreaks of which India is everywhere subject, except in areas 5,000 ft. above sea-level and a few widely separated regions. In the large cities such as Bombay and Delhi control measures are being successfully carried out, but rural malaria is a difficult problem. The general policy of provincial authorities is to provide an adequate supply of quinine or cinchona febrifuge to popularize the use of these drugs and to provide for their distribution by travelling dispensaries. The greatest sources of danger from yellow fever lies in the air-traffic passing through infected areas in Africa. Under Government rules any person who has been in a yellow fever area is forbidden to enter British India until nine days after exposure, unless he has been inoculated or is protected by a previous attack.

Fuel Analytical Methods

THE analysis of solid fuels, as befitting its technical importance, is described widely in technical literature. The treatment, usually confined to the proximate analysis, is so familiar as to give an appearance of simplicity which is not in fact warranted. Many pitfalls occur, especially when somewhat abnormal fuels are in question. This emphasizes the need for specification when commercial transactions are involved and has led to the production of British Standard Specifications. Even these can only prescribe methods to secure uniformity of procedure, and there is a need for a critical treatment of fuel analytical methods.

The Fuel Research Board is well qualified to undertake this task because in the physical and chemical survey of coal its staff examines every kind of coal found in Great Britain, and many elsewhere. Its experience is embodied in "Methods of Analysis of Coal and Coke" Paper No. 44 of the Physical and Chemical Survey of Coal Resources (H.M. Stationery Office). The methods given are not always identical with those in the B.S.I. Specification and at times include refinements unlikely to be used in technical practice. These elaborations may, however, at any time be required. Most of the possible components of coal are mentioned. It is worthy of comment that in a book of this character it is still considered sufficient to limit the treatment of 'ash' to a determination of the residue on ignition—composition, fusibility, physical structure and density being ignored.

Beetle Pests of Furniture

UNDER the title of "Beetles Injurious to Timber and Furniture" a bulletin was issued in October last by the Department of Scientific and Industrial Research which gives an account of the damage and losses caused by these insects. It is based on the

text of Bulletin 9 of the Forestry Commission by Prof. J. W. Munro, which is now out of print. The new bulletin, which is a revision and amplification of its predecessor, has been written by Dr. R. C. Fisher in consultation with Prof. Munro and includes the results of recent investigation. The longhorn and pinhole borers are essentially forest insects: they attack recently felled timber, but abandon it during the drying and seasoning. The powder-post and furniture beetles are enemies of seasoned woods, the former abounding in timber yards and the latter attacking antique furniture and the structural timbers of old buildings. The losses occasioned by these different classes of beetles are often very great, and the present bulletin gives a clear and well-illustrated account of how to avoid or reduce the damage by the adoption of preventive and remedial measures. The publication, which is Forest Products Research Bulletin No. 19, is obtainable from His Majesty's Stationery Office, or through any bookseller, price 1*s*. 6*d*. net.

Evolution of Weapon Types and Design

IN the *Journal of the Franklin Institute* of October, Brigadier-General Earl McFarland, of the United States, has published a paper on the trend in weapon types and design. He first gives a sketch of the story of man's effort to adapt scientific principles to self-defence. Each of the great civilizations of history developed something new in the art of warfare. The epoch-making invention of gunpowder by the Chinese is placed first in the list. The period since the Napoleonic wars has seen the introduction of steel and its application to gun manufacture and projectiles. The development of chemistry has led to the manufacture of propellants and explosives exceeding by many times the effectiveness of the cruder preparations of a century ago. The development of military weapons during the last three generations has been greater than during the entire previous period of recorded history. The invention of the petrol engine had a revolutionary effect vastly increasing both the tactical and strategic mobility on the ground and in the air.

The United States Congress in 1794 passed an Act which provided for the establishment of a system of Government-owned shops for the manufacture of muskets. At the Springfield Armory, Massachusetts, the musket or rifle has been produced continuously for 144 years. The Frankford Arsenal, organized only twenty years later than Springfield Armory, has carried on without interruption, in war and in peace, the manufacture of ball, armour-piercing and tracer ammunition for rifles and machine-guns; it is now manufacturing the mechanical time fuse. American troops are being armed with the semi-automatic shoulder rifle, officially known as U.S. Rifle, Calibre ·30 Ml., but often referred to as the Garand rifle, from J. C. Garand, an ordnance engineer of Springfield Armory, who was mainly responsible for its design and development. The trend in rifle design is toward the type which demands the least time of training and which gives the greatest number of aimed shots per minute with the minimum fatigue to the firer. At the present moment, a contest is going on between the anti-tank gun and tank armour. The gun is sure to win in the long run.

Interior Lighting and Decoration by Fluorescence

NEW effects in interior decoration have been obtained recently by using fluorescent paints and ultra-violet lamps. In the Hawaii Theatre opened in the early summer in Hollywood the whole of the walls and ceilings have been covered with fluorescent paint. When cinema pictures are shown the ultra-violet lamps are switched on, but no other illumination is used. The whole auditorium then seems to be bathed in 'shadowless moonlight' and the walls appear to have receded. The audience has the impression of sitting under a deeply luminous blue Hawaiian night sky with brightly glowing stars. In earlier attempts at interior decoration by fluorescence, blues and greens preponderated to give only a limited range of colours. A sufficient number of paints, twelve in all, has now been developed so that landscapes can be painted on the walls. A panel of Mount Manua Loa spouting fire and smoke gives the impression of many miles in distance. The fluorescent materials can be had as either solid paints or transparent varnishes. White fluorescence is obtained by applying two complementary colours, such as a red and a green, so that at a distance from the surface the light mixes well enough to give an effect of white light. The transparent varnishes are invisible in ordinary light.

Advertising signs have been made to give one picture in natural light and a second picture in filtered ultra-violet—'black light'. Carpets have also been impregnated with fluorescent substances. Details of all the products can be had from Conti-Glo Paint, Continental Lithograph Corp., 952 East 72nd Street, Cleveland, Ohio. The literature supplied is concerned with the decorative and third-dimensional effects. As, however, the use of ultra-violet light is an essential part of the scheme it would appear that, by extending the range of the ultra-violet sources, air sterilization could also be combined with the new decorative effects. In hospitals at night, where low-level illumination is needed, the patients could have the beneficial effects of air sterilization together with rest under a "deeply luminous blue Hawaiian night sky".

Testing Steel Rails

A DESCRIPTION is given in the *Electrical Review* of November 22 of the method developed by Sperry Products, Inc., Hoboken, New Jersey, U.S.A., for examining steel running rails of railways *in situ* for internal defects. A recording car is used, and operation is based on the fact that any internal discontinuity in a metal bar creates an area of high resistance to the flow of direct current; consequently a difference of potential will occur at the site of the internal flaw. Indicating currents are conveyed to the track rails by brush holders attached behind the front bogie and underneath the frame of the rear bogie of the

coach. A current of about 1,500 amp. up to 8 volts is injected for pre-energizing the rails to ensure uniformity of molecular arrangement prior to the introduction of the detecting current just in front of the two pairs of searching coils. This precaution is necessary because running rails are generally magnetized by the normal effect of the earth's field, augmented by vibration due to the pounding of passing train wheels.

The magnetic poles strongly formed in this way are of two kinds; the effects of the superficial ones on the surface of the rail can be avoided by the use of suitable brush gear for conveying the test current to the rails, while those within the railhead can be overcome by raising the detective current density to 275 amp. per sq. in., which means feeding 4,000 amp. to each rail at up to 4 volts. The testing currents are furnished by a petrol engine with gear-box and multiple belt pulley which drives the main current (8,000 amp.) and auxiliary (pre-energizing) generators and a 200-volt exciter mounted together in the car. The recording tape moves at 0·025 in. per ft. of car travel; the recording car travels at seven miles per hour when fault detecting. It is reported that in seven months this year 597,000 miles of track, tested in this way, revealed 304,000 defective rails.

Movable Electric Generating Stations

THE Commissariat of the Building Industry of the U.S.S.R. is constructing 1,000 movable electric generating stations for use in timber camps and on railway construction jobs. The movable generating stations will be of various capacities, beginning with the smallest, of 2·5 kw., which will be used by railway maintenance men. Generators of this capacity will be installed on hand-carts and moved about from place to place as required. Electric generating stations of 30 kw. capacity will be fitted on the running-boards of automobiles and worked by the motor engine. A novel feature of the electric power stations of 50 kw. capacity will be a gas generator, instead of the ordinary Diesel engine, which will effect a considerable saving of fuel.

New Seismographs for Boulder Dam

AN ambitious, though necessary, seismological programme is being undertaken in the neighbourhood of the Great Boulder Dam (*Earthquake Notes*, **22**, Nos. 1 and 2, September 1940). A Wood-Anderson seismograph has been operating for several years at Boulder City, and two Neumann-Labarre vibration meters are temporarily installed at Overton, Nevada. The seismograph buildings at Pierce Ferry on Lake Mead are almost ready to house the temporary Coast and Geodetic Survey vibration meters. The construction of permanent Benioff instruments recording on 35-mm. motion picture film for all three stations is nearing completion. Four records, two horizontal, one vertical and one 'time record', will be made simultaneously on one drum. The 'time record' will be a film on which radio time signals will be recorded at regular intervals several times each day in addition to the regular chronometer time marks. Through the use of a reading microscope with two-way micrometer control, it will be possible to read time from the record to the nearest hundredth of a second and to measure amplitude to corresponding precision. Another feature of the seismographs is a second vertical seismometer used to control relays for intensifying the recording light at times of recording strong seismic disturbances.

Earthquake in Chile

ON the basis of instrumental reports from fourteen seismographic observatories, the United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentre of the earthquake of October 11, 1940, to be provisionally at latitude 45° S., longitude 73° W. This is on the mainland of Chile opposite the Chanos Archipelago and north of Taitao Peninsula. It has been the scene of many small earthquakes and earth tremors in the past.

Announcements

PROF. HUGO ILTIS, formerly director of the Mendel Museum in Brno, has been appointed professor of biology in Mary Washington College, Fredericksburg, Virginia.

PROF. TH. DOBZHANSKY, formerly professor of genetics in the California Institute of Technology, Pasadena, has been appointed professor of zoology in Columbia University, New York.

DR. A. C. SMITH, formerly associate curator of the Herbarium, New York Botanical Garden, has been appointed curator of the Herbarium of the Arnold Arboretum, of Harvard University.

THE following appointments in the Colonial Service have recently been made: J. E. Hardy, chief plant protection officer, Palestine; J. K. H. Wilde, veterinary research officer, Tanganyika.

AT a Congregation of the Senate of the University of Cambridge on December 9, degrees of M.A. *honoris causa* were conferred on Prof. A. M. Carr-Saunders, director of the London School of Economics and Political Science; Prof. F. L. Hopwood, professor of physics in the University of London (St. Bartholomew's Hospital Medical College); and Prof. A. E. Richardson, professor of architecture in University College, London.

THE British Museum (Natural History) has recently published three additions to the series of "Economic Leaflets". These are No. 4, "Psocids, Book Lice, Dust Lice, etc."; No. 5, "Crickets"; and No. 6, "Plaster Beetles". Each type of insect dealt with is clearly illustrated and an account is given of its habits, the injuries that it may cause and the best means of controlling it. The leaflets are sold at the British Museum, Cromwell Road, London, S.W.7, price 1*d*. each for Nos. 5 and 6, and ½*d*. for No. 4.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Collisions of Neutrons with Deuterons and the Nature of Nuclear Forces

ATTEMPTS to decide the nature of the forces between elementary nuclear particles by investigation of the distribution in angle of protons projected by neutrons have so far proved fruitless. This is because the only source of neutrons, homogeneous in velocity, at present available is the D – D reaction, which yields neutrons of 2·2 mv. energy. The wave-length of these neutrons is so long compared with the range of the neutron – proton forces that only those particles which make head-on collisions are effective in the scattering. These particles give an isotropic distribution of the scattered intensity in relative co-ordinates independent of the nature of the neutron – proton force.

To obtain information more sensitive to the nature of the forces it is necessary to investigate collisions of neutrons with simple nuclear structures of dimensions comparable with the wave-length of 2·2 mv. neutrons. We have therefore carried out a detailed theoretical investigation of the collisions of neutrons with the simplest of such structures, namely, deuterons.

The interaction energy between any two nuclear particles, ij, was taken to be of the form

$$-\left[mM+hH+\left\{\tfrac{1}{2}(1-x)-h\right\}B+\tfrac{1}{2}(1+x)-m\right]Ae^{-\alpha r_{ij}},$$

where M, H, B are the Majorana, Heisenberg and Bartlett exchange operators. x is the ratio of the force between particles of opposite spin to that between particles with the same spin and has the known value 0·6. The constants A and α were taken to be those given by Present and Rarita[1] as the ones which lead to binding energies of H^3, He^3, He^4 in best agreement with that observed. Three distinct sets of values of m and h were taken for detailed calculation :

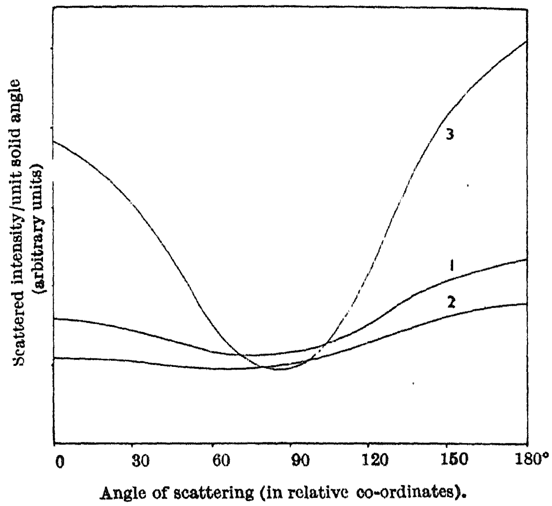
(1) Mixed exchange force.
$m = \tfrac{1}{3}(1 + 3x)$, $h = \tfrac{1}{3}(1 - 3x)$.

(2) Majorana-Heisenberg exchange force.
$m = \tfrac{1}{2}(1 + x)$, $h = \tfrac{1}{2}(1 - x)$.

(3) Ordinary force.
$m = 0$, $h = 0$.

The method employed in calculating the scattering follows that of resonating group structure introduced by Wheeler[2]. Exchange of particles is taken into account but the polarization of the deuteron by the incident neutron is neglected. The integro-differential equations involved were solved by numerical methods.

In Fig. 1 the calculated angular distribution, in relative co-ordinates, for the scattering of 1·85 mv. neutrons by deuterons is illustrated for each of the assumed types of force (1), (2) and (3). It will be seen that curve 3, corresponding to ordinary forces (case (3)), shows a much more marked variation of scattering with angle than either of the other



CALCULATED ANGULAR DISTRIBUTION (IN RELATIVE CO-ORDINATES) OF NEUTRONS OF 1·85 MV. ENERGY SCATTERED BY DEUTERONS.

Curve 1, assuming 'mixed' exchange forces.
,, 2, ,, Majorana-Heisenberg exchange forces.
,, 3, ,, 'ordinary' forces.

two. The recent experiments of Barschall and Kanner[3] indicate that there is little variation in scattered intensity in the angular range of their observations (70–135°). This suggests that the fundamental nuclear forces are really of exchange type approximating to (1) or (2).

The evidence from the total collision area Q also points the same way. The measurements of Aoki[4] give $Q = 2\cdot2 \times 10^{-24}$ cm.^{2} for D–D neutrons. We find for cases (1), (2) and (3) respectively 2·25, 1·79 and $3\cdot37 \times 10^{-24}$ cm.^{2}, strongly favouring (1).

It thus appears that very useful evidence regarding nuclear forces can be obtained by a detailed study of neutron – deuteron collisions. It is hoped that further experimental evidence will be forthcoming.

A detailed account of the theory will be published in the *Proceedings of the Royal Society*. It would not have proved possible to complete the numerical solution of the equations involved but for a grant from the Government Grants Committee of the Royal Society, which enabled us to employ the professional services of the Scientific Computing Service.

H. S. W. MASSEY.
R. A. BUCKINGHAM.

University College,
London.
Nov. 19.

[1] *Phys. Rev.*, **51**, 788 (1937).
[2] *Phys. Rev.*, **52**, 1083 (1937).
[3] *Phys. Rev.*, **58**, 590 (1940).
[4] *Proc. Phys.-Math. Soc. Japan*, **21**, 232 (1939).

The Possibility of Detecting a Doubly-Charged Proton by the Photographic Method

BHABHA[1] has recently shown, on theoretical grounds, that there probably exists a proton having a double charge. Such a particle might be expected to occur in the nuclear explosions produced by cosmic rays, and it has been suggested that the most likely way of detecting it would be by examining the tracks which are found in photographic plates exposed at a high altitude.

We have here a number of Ilford 'R' plates which, by the kindness of the Rev. W. Asboe of Leh, Kashmir, we were able to place at a height of more than 18,000 ft. in the Himalayas. A full study of these plates has yet to be made, but at the suggestion of Dr. Bhabha we have examined some areas to see whether they furnish any evidence for the existence of the doubly-charged proton. The plates show large numbers of tracks, many of which are doubtless due to protons, and some hundreds of them have been measured. We conclude, however, that the resolving power of the method is insufficient to reveal the new particle, for reasons which we will briefly indicate.

In general, there are two criteria for classifying tracks of unknown origin: (*a*) total length, (*b*) mean grain spacing, *s*. The first criterion is here of little use, for we can seldom be sure that the whole path of a particle is fully recorded in the emulsion. Other causes of uncertainty in length measurements have been discussed elsewhere[2,3]. Some workers[4] have based important conclusions on the distribution of track lengths, claiming a fairly high resolving power, but this is only in special types of experiment, under controlled conditions, where the tracks are produced by known ionizing particles of one kind.

The second criterion has also been previously discussed[2,3]. The *s*-value depends on the ionizing power of the particle producing the track. It has a minimum value for α-particle tracks, since an α-particle ionizes sufficiently strongly to affect practically every grain it encounters. (Heitler[5] reports a track with three times the grain density of an α-particle track, which he interprets as due to a heavy particle of very high effective charge. This conclusion is difficult to understand, for the implication that the α-particles affect only one grain in three is contrary to previous results.) The *s*-value enables us to distinguish proton from α-particle tracks with certainty when the tracks are long, but for short tracks there is uncertainty, since the distribution curves for *s* overlap. Bhabha[1] has shown that the doubly-charged proton would have a mean ionization, for the same range, about twice that of a proton, so we may expect the mean grain spacing, in tracks of these particles, to be intermediate between the values for α-particle and proton tracks. If therefore the distribution curve of *s*, for a large number of measured tracks, were to show three well-defined peaks, it would be legitimate to interpret the middle one as evidence of the doubly-charged proton. Even in the ideal case, however, with plates containing only the tracks concerned, and free from background grains, such a group could not be distinguished unless it contained a relatively large number of tracks. The overlapping of the two end groups would entirely mask a small intermediate group.

In the present experiments the ideal conditions are far from being realized. After four months exposure to penetrating radiation, the plates contain tracks due to all kinds of ionizing particle, and the number of background grains is naturally very much greater than on unexposed plates. These grains seriously interfere with the measurements. One can seldom be confident that the end grains of a track have been correctly located, and the number of grains to be assigned to a track is often doubtful. These uncertainties necessarily decrease the resolving power. Moreover, it is to be expected that the doubly-charged proton will be relatively infrequent, so that only a small proportion of the tracks will be due to this particle. Under these conditions, it is not surprising that our values of *s* for the measured tracks are distributed almost uniformly between $1 \cdot 5\,\mu$ and $4 \cdot 5\,\mu$, and give no indication of different groups of particles.

It is possible that half-tone or process plates, which have been used by some workers, may have a somewhat different resolving power, but as 'R' plates are specifically designed to have the most suitable characteristics for track recording, it is improbable that a different choice of plate would give an appreciably better result. In this particular type of experiment the lack of resolving power seems unavoidable. There are undoubtedly problems to which the method of the photographic plate can be advantageously applied; but we think it unlikely that a definite decision regarding the existence of the doubly-charged proton can be reached by this method.

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Sept. 28.

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South African Senecio Alkaloids

Manske[1] and Barger and Blackie[2] isolated from *Senecio retrorsus* of South African origin the alkaloid retrorsine, $C_{18}H_{25}O_6N$. Chemical investigations by me have since led to the isolation from the same species also of isatidine, $C_{18}H_{25}O_7N$, and a new alkaloid, possibly $C_{18}H_{25}O_8N$. The latter two alkaloids are water-soluble but insoluble in chloroform, and have a peroxide nature.

Catalytic hydrogenation of isatidine leads to the consumption of four molecules of hydrogen per molecule of alkaloid. Three molecules of hydrogen saturate three ethylenic linkages (two in the basic fission product and one in the acidic fission product). A fourth molecule of hydrogen combines with one peroxygen atom, which is present in the acidic portion of the molecule and which is then removed as one molecule of water. The hexahydro-desoxyisatidine ($C_{18}H_{31}O_6N$) so formed is crystalline.

The dibasic isatinecic acid, $C_{10}H_{16}O_6$, and the base isatinecine, $C_8H_{13}O_3N$, are obtained by hydrolysing isatidine with barium hydrate. Isatinecic acid has

one ordinary carboxylic group and one percarboxylic group $\left(R\begin{matrix}\diagup COOH \\ \diagdown CO.O.OH\end{matrix}\right)$ which readily lactonizes to form a monolactonic monobasic acid, $C_{10}H_{14}O_5$, which is no longer a peracid, but contains the peroxygen atom in the lactone ring.

From *S. rosmarinifolius* Linn. a new alkaloid rosmarinine, $C_{18}H_{27}O_6$, has been isolated which yields on hydrolysis a new base rosmarinecine, $C_8H_{15}I_3N$, and senecic acid, $C_{10}H_{14}O_4$. Rosmarinine has one double bond only, that is, the one present in senecic acid and which can be hydrogenated catalytically to the saturated dihydrosenecic acid.

S. pterophorus D.C. contains besides retrorsine a new alkaloid pterophine, $C_{18}H_{23}O_5N$, which can be hydrolysed to retronecine, $C_8H_{13}O_2N$, and pterophnecic lactone, $C_{10}H_{16}O_6$.

The Senecio species responsible for 'bread-poisoning' in human beings in the Cape south-western districts, namely, *S. ilicifolius* Thunb., contains three toxic alkaloids, senecionine, pterophine and retrorsine.

These alkaloids are all physiologically active and contain the pyrrole nucleus typical of other Senecio alkaloids. Details of these results will be published in the *Onderstepoort Journal* in due course.

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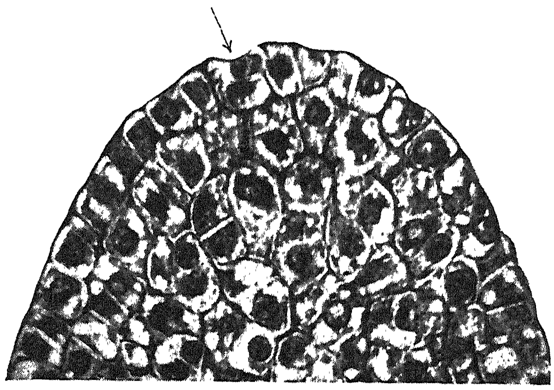
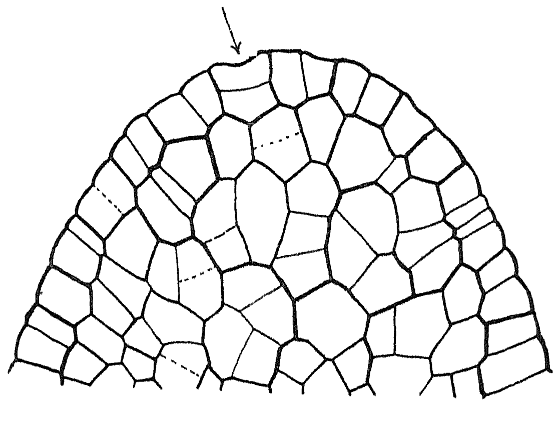
A Periclinal Division in the 'Dermatogen' at the Tip of the Maize Growing Point

THE accompanying photomicrograph and the cell-wall drawing show the periclinal division of a single isolated cell in the 'dermatogen' of a maize growing point (L.S.). In the more primitive vascular plants it has long been recognized that the outer layer of cells contributes to the central tissues of the apex by periclinal divisions. Recent workers have confirmed this for Lycopodium[1], and a number of Gymnosperms[2,3,4,5]. The above case shows that even in the Angiosperms, and even at the extreme apex in these, periclinal divisions sometimes occur in the outermost cell layer.

In the case of the cell concerned, its general shape, its position high up on the apex, the well-vacuolated cytoplasm of the daughter cells and the lack of rapid anticlinal divisions in the cells on either side, clearly indicate that the division is an isolated one and is not in any way foreshadowing the initiation of a leaf primordium. Examination of the series (cut at 5 μ) showed traces of the single division, at the same point in the cell, in at least three sections.

It is now generally agreed that there does not exist a dermatogen in the strict sense of the term as originated by Hanstein, since the outer layer often undergoes periclinal division during leaf formation. In the Dicotyledons it may be involved in the production of the leaf edge, while in the Monocotyledons it is frequently concerned in the initiation of the leaves and often contributes considerably to their inner tissues (Alstroemeria[6], Orchis[7], Dactylis[8], Triticum[9], Avena[10], and Tradescantia[11]). In more than twenty species of grasses (that is, in every one I have so far studied) periclinal 'dermatogen' divisions play their part in leaf primordia initiation. So far, how-





ever, there does not seem to be any case recorded of the 'dermatogen' contributing to the inner tissues of the apex. The case illustrated shows that it does sometimes occur in Angiosperms: perhaps future observations will throw more light on this point.

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Nov. 14.

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RESEARCH ITEMS

Carbonic Anhydrase

THE physiological significance of zinc in the organism has been demonstrated for the first time by Keilin and Mann (*Biochem. J.*, **34**, 1163; 1940) who show that carbonic anhydrase is a zinc protein compound. This enzyme, which catalyses both phases of the reversible reaction $H_2CO_3 \rightleftarrows CO_2 + H_2O$, was discovered in 1933 by Meldrum and Roughton and was obtained as a colourless substance free from hæmatin and other known enzymes, stable within pH 3–12, thermolabile and very sensitive to KCN, H_2S, NaN_3 and to several heavy metals. The enzyme has now been prepared in pure or almost pure condition, having a catalytic activity 150 times that of the red blood corpuscle. As prepared from erythrocytes of ox and sheep by different methods, the enzyme has a constant zinc content of 0·33 per cent and contains no other metal. Also the enzyme activities of different fractions from erythrocytes and gastric mucosa run parallel to their zinc content. In the Tiselius cataphoresis apparatus the enzyme behaves like a homogeneous protein. Ultracentrifugal studies show that the enzyme has a size approximately half that of the hæmoglobin molecule, and hence each molecule contains two atoms of zinc. 100 ml. of erythrocytes contain about 0·21 gm. carbonic anhydrase, 0·06 gm. hæmocuprein and 28 gm. hæmoglobin. It is pointed out that carbonic anhydrase is the only known zinc compound which has characteristic catalytic properties, in contrast to zinc porphyrin, zinc insulin and zinc protein compounds of serum and tissues. Iron and copper are able to form compounds with different proteins, either acting as carriers of molecular oxygen or capable of catalysing a series of completely different reactions. The fact that the distribution of zinc in Nature is so much wider than that of carbonic anhydrase only shows that zinc, like iron and copper, forms with protein, compounds having different properties and functions.

Translocation of Minerals in Cotton

THERE seems to be quite general agreement as to the tissues responsible for the movement of sugars and water in the higher plant, but the position with regard to mineral nutrients still remains somewhat obscure. Another attempt to solve this latter problem has recently been made by Phillis and Mason, using as indicators of translocation, calcium (immobile in phloem) and phosphorus (mobile in phloem) (*Ann. Bot.*, N.S. **4**, 635; 1940), and bromine (*loc. cit.*, p. 651). Sea Island cotton plants were used, and in the first investigation was confined to roots, stem, and two branches by judicious removal of developing buds. In this work, one set of plants were ringed at the base of one branch. There was an initial collection of normal plants and three subsequent collections of ringed and normal plants over a period of fourteen days. Ringing caused a slight reduction of both calcium and potassium uptake in the plant as a whole, but the ringed branch itself was found to contain more potassium and less calcium than either the unringed branch or the branches of the normal group. The results are in harmony with the view that the bulk of the solutes move upwards in the wood and, provided they are mobile in the phloem, are re-exported down the stem in this tissue. Phosphorus is trapped by the ring and therefore accumulates. The effect of transpiration on mineral uptake is the subject of the second paper. The authors point out that previous attempts to separate the effects of transpiration and assimilation (leading to transport of sugars to the roots and a possible change in uptake) have been largely unsuccessful; they therefore observed plants in which the roots are isolated by a phloem ring at the cotyledonary node. After two hours exposure to light both normal and ringed plants had absorbed bromine rapidly. While the presence of the ring had depressed slightly the uptake of bromine by the roots (below the ring) no appreciable difference was observed between the tops of the two series. Subsequent determinations on ringed plants in light and in darkness established the fact that transpiration increases uptake of bromine. It is suggested that transpiration affects uptake by altering the concentration in the absorbing region of the root (and possibly also by oxygenating the root), while assimilation is active by altering the solvent capacity of the root. Mineral nutrients thus appear to travel up the stem in the wood; whether, in normal plants, a proportion also ascends in the phloem is not yet clear.

Diseases of Pasture Grasses

THE age-long practice of grassland farming is now enlarged to include the finer aspects of its technique. 'Winter burn' is a significant condition of poor yield which scarcely troubled our grandfathers, but is now recognized as worthy of investigation. Kathleen Sampson and J. H. Western, in a study of possible mycological contributions to this state, have described two grass diseases new to Britain (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 255–263; 1940). These are caused by the fungi *Helminthosporium siccans* and *H. vagans*. The former produces oval chocolate-brown spots upon the leaves of rye grass and meadow fescue; the latter induces dark purplish-red lesions upon the foliage of smooth-stalked meadow grass. *H. vagans* appears to attack from infested soil, whilst *H. siccans* seems to depend more upon aerial methods of spore dispersal. Neither disease is severe of itself, but their possible contribution to a general condition of low yield warrants their study by mycologists in this disease-conscious age.

Rust Fungi Attacking the Thistle

SEVERAL species of thistle are subject to attack by various rust fungi, the taxonomy of which has been somewhat confused. Dr. Malcolm Wilson has investigated this subject (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 244–250; 1940) and has found that the greatest discrepancy lies in the identification of *Puccinia Syngenesiarum* on *Cnicus palustris*, which is usually *P. Cirsii-palustris* (*P. Le Monnieriana*) on that host. *P. Cardui* and *P. Circii-oleracei* are often wrongly recorded upon *Cnicus lanceolatus* as host, for they appear to confine their parasitism to other species of the host genus.

Foliage Blight of the Bulbous Iris

THE growth of bulbous Irises upon a commercial scale in the south-west of England has accentuated several maladies such as ink disease and leaf spot. Still another parasite has been discovered in a Phytophthora blight of the foliage, recently described by Gordon W. Gibson and P. H. Gregory (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 2, 251–254; 1940). This fungus, which is possibly related to *P. Cyperi-rotundati*, causes the appearance of ill-defined whitish lesions upon the leaves. Spore characters are described, but the fungus has hitherto defied artificial culture. Suggested control measures are based upon methods of plant sanitation.

Standard Disks in the Strain Testing of Glass

A PAPER on this subject was read by E. J. Gooding at a meeting on November 20 of the Society of Glass Technology. Glass disks with standardized degrees of strain (described shortly as standard strain-disks) have been used at eleven bottle factories and one other glass factory. The results and comments of the observers were correlated by the author. Four different types of strain-viewer have been used, and a large variety of glassware has been examined in respect to its weight, thickness and contents capacity. The method is most easily employed in conjunction with a strain-viewer which has a large, uniformly illuminated field of view, with uniform polarization over a relatively large area. In general it is agreed that the strain disk method of comparison is simple and trustworthy, is useful for training personnel, and that good agreement between different observers is obtained. When the degree of strain is small, observers rarely disagreed by more than one disk, colourless or pale green bottles being used; but when it is greater than normal, agreement between observers is not so good. The disks are not particularly suitable for use with amber or dark green bottles unless a suitable colour tint plate can be superimposed on them. It is agreed that for bottle examination no revision of the degree of strain of the disks is necessary. Only about 1·5 per cent of the ware examined has a strain grading greater than three disks.

Sydney Observatory Astrographic Catalogue

THE section of the sky assigned for purposes of the Astrographic Catalogue to the Sydney Observatory lies between − 51° and − 65° declination. Of the fifty-two Catalogue volumes which publication of this work will necessitate, seventeen have now been issued. The latest (22. Sydney, 1940) covers − 56° to − 58°, 6–12 hr. in right ascension. It gives, in the usual way, rectangular co-ordinates and diameters of the star images. The latter, however, are not linear measures, but indicate the grade of the image according to a calibrated scale of comparison images used in the micrometer. Plate constants have not yet been computed, but space is left for their insertion when available, in the appropriate positions in the catalogue.

Variation of Faint Fraunhofer Lines

M. G. ADAM showed in 1938 (*Mon. Not. Roy. Astro. Soc.*, **98**, 112; 1938) that there was an anomalous behaviour of faint Fraunhofer lines towards the limb of the sun, for the region λ 5100. From absolute measurements at centre and limb it was shown that the equivalent widths of strong lines decreased to the limb, in accordance with theoretical considerations, but that faint lines showed a marked strengthening for which no explanation could be given by the usual theories of line formation. The latter phenomenon was finally ascribed to reduced re-emission in faint-line frequencies, which was interpreted as interlocking. The possibility of interlocking does not exist for all faint lines, and the correctness of the interlocking hypothesis has now been tested by the method described by Adam (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The term 'rare-element faint lines' is applied to the Fraunhofer line which may be faint because it originates from an oscillator of low relative abundance, and the term 'abundant element faint lines' is used if the line originates from a transition of low probability in an abundant oscillator. Equivalent widths at centre and limb of the sun were obtained for twenty-three rare-element faint lines and seventeen abundant-element faint lines in the region λ 4100, and for both classes a marked increase in equivalent width at the limb was established. The abundant-element faint lines showed a slightly greater increase than the rare-element faint lines. An examination is made of the existing theories of absorption-line formation, the two types of atmospheric models being considered, the Schuster pure scattering atmosphere model and Eddington's model, in which the continuous spectrum is formed all the way up in the atmosphere. The conclusion is that the strengthening of faint lines is due to an anomalous temperature distribution in the outer layers of the solar atmosphere.

Distribution of Sunspots Over the Sun's Disk

G. H. A. ARCHENHOLD has discussed the distribution of sunspots as a function of longitude from the central meridian (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9; June 1940). The material utilized was taken from the Greenwich Photoheliographic Results, and the daily results up to the year 1915 give the details of the position and area of single spots and also of the more important individual spots composing the groups. There is evidence that the area of a sunspot, which has already been corrected for geometrical foreshortening, is also affected by physical foreshortening, which increases from centre to limb and also slightly from small to large spots. At long. 65° the physical foreshortening amounts to about 10 units of area, and at long. 80° it amounts to about 50 units (a unit is the millionth of the sun's visible hemisphere). The physical foreshortening, implying that a sunspot appears smaller if looked at from a greater angle of observation even when its area is corrected for the geometrical foreshortening, suggests a structural feature of sunspots. If a sunspot has the shape of a flat dish or funnel, it should show an increase in corrected area as it approaches the limb, because, with increasing inclination to the line of sight, the depth to which an observer can look into the sun decreases. From the observational facts given in the paper it is evident, however, that the cross-section of a sunspot decreases in the higher levels of the sun's surface, and this view is confirmed by certain theories of spots advocated by Minnaert and Wanders about eight years ago. Among other matters discussed is the Maunder effect, which amounts to an eastern excess of 7·5 ± 1·4 per cent (mean error) for groups in the period 1888–1915, the physical cause of which can be found in the slope of the axes and the preponderance of faculæ on the eastern side of sunspots.

BRITISH RHEOLOGISTS' CLUB

INAUGURAL MEETING

At the inaugural meeting of the British Rheologists' Club held at the University of Reading on November 16, a discussion on "Rheology in Industry" was introduced by Mr. J. Pryce Jones. In the unavoidable absence of the president, Prof. G. I. Taylor, the chair was taken by Prof. J. A. Crowther.

Rheology is defined as the 'science of the deformation and flow of matter', and Mr. Pryce Jones stressed the diversity of materials and of the properties of materials which the rheologist has to study. He went on to propose that the Club, or a committee appointed within it, should attempt to make a classification of the essential rheological properties of a number of industrial materials so as to construct a rheological table such as was recently proposed and attempted on a limited scale by Scott Blair (*J. Sci. Inst.*, **17**, 169; 1940). But first it is essential to define the terminology to be used. Such a term as 'thixotropy' is used by different workers in very different senses, and even when the original definition of Freundlich is referred to, definitions of the terms 'sol' and 'gel' are by no means standardized.

Mr. Pryce Jones went on to discuss the property of *Spinnbarkeit*, and gave some interesting demonstrations of both this and thixotropy, but the main part of his paper was concerned with a description of an extremely ingenious new viscometer especially designed for the study of anomalous liquids. This instrument, shortly to be described in the literature, consists of two Couette units rigidly attached to one another and rotated at the same speed in opposite directions. One of these contains an oil or other true fluid of known viscosity, and in the other is placed the materials to be investigated. The speed at which the couettes rotate can be varied, but if both contain true fluids, the frame connecting the two does not rotate so long as the speed of both is the same. If one of the couettes contains a material the viscosity of which varies with rate of shear, a deflection is observed and can be measured.

Mr. Pryce Jones concluded by discussing the connexion between anomalous viscosity and elastic recoil.

Mr. F. D. Farrow urged the importance of a careful scrutiny of the way in which rheological data are published. Since the methods of analysing such data are still in many cases tentative, it is important that the experimental figures should be given in their original form. The definitions of the term 'sol' and 'gel', 'solid' and 'liquid' were much discussed, Mr. Pryce Jones proposing that any system showing elastic recoil should be classed as a gel, and asking whether anomalous viscosity need be in all cases associated with elastic recoil. Dr. P. Halton and Dr. P. White also spoke on this point, the latter suggesting that, if we regard truly elastic behaviour as analogous to bright sunlight, and truly viscous behaviour to complete darkness, most industrial materials would fall in the twilight zone, and that consequently the distinction between 'sol' and 'gel', though convenient in practice, may be illusory in theory.

Dr. G. W. Scott Blair congratulated Mr. Pryce Jones on his most interesting new viscometer (as did several other speakers) but questioned the advisability of his definition of 'gel', which would include many quite dilute sols such as ammonium oleate (see Hatschek and Jane, *Koll. Z.*, **40**, 53; 1926).

It was generally agreed that the closer co-operation which the new Club can make possible between rheologists working in different industries will be extremely valuable. That this was appreciated was shown by the fact that the Club already has a membership of sixty-five, and that in spite of the difficulties of the present time, about twenty-five were present at the meeting.

ELECTRICAL DEVELOPMENT IN THAILAND (SIAM)

A series of useful articles are being published in the *Electrician* which will prove helpful to electrical manufacturers looking for export markets. In the issue dated November 15, the export market to Thailand (formerly Siam) is discussed.

During the past few years Thailand has developed a sound constructive policy, including the promotion of land, water and air transport and communications. This widespread plan, which as well as including road making, also provides for the improvement of harbour facilities at Bangkok.

Under its scheme of development, the Government spent 370,000 ticals (11 ticals = £1) on its wireless broadcasting station during the period April 1, 1938—March 31, 1939 (year of the Buddhist Era 2481), 2·2 million ticals on the Post Office, 4 million ticals on transport and development at the port of Bangkok, and 103,000 ticals on turbines for the Samsen power station. Over a period of four years there has been a steady increase in the demand for electrical goods, apparatus and machinery. This followed naturally from the development of municipal amenities. The figures for 1937–38 show electrical imports of 2,575 thousand kilograms, valued at more than 3 million ticals.

Analysing these figures, the United States led with imports valued at 823,000 ticals; Germany took second place with a value of 553,000 ticals; from the

United Kingdom the imports were valued at 405,000 ticals. Japanese competition was confined mainly to cheap electrical goods, including lamps, and was responsible for a total of 330,000 ticals.

Comparing these figures with those for 1936–37, during which period Thailand imported nearly $2\frac{1}{2}$ million ticals worth of electrical goods and apparatus, it is possible from the figures given to gauge to some extent the growth of the market. Figures for the total of all imports show that in 1936–37, the United Kingdom supplied goods to the value of more than 11 million ticals; Germany nearly 6 million ticals, and Japan more than 28 million ticals. For 1937–38 they show that the total of goods supplied were more than 13 million for the United Kingdom, nearly 7 million from Germany, and 22 million from Japan. This reflects a slackening of the Japanese competition.

Bangkok, the principal city, is developing rapidly. Up-to-date electric tramways are in operation. The first public wireless service between Thailand and foreign countries was inaugurated in 1929, and to-day Bangkok is in direct communication with eleven foreign stations—Berlin, London, Paris, Tokyo, Hong Kong, Manila, Saigong, Bandoeng (Netherlands East Indies), Calcutta, Penang and Rangoon.

There is in operation a wireless telephone service between Thailand and Europe, as well as a radio picture telegraphic service and radio service for air and marine navigation. For internal wireless communications, stations have been established at various centres. In 1937 a medium wave transmitter of 10 kw., working on a wave-length of 400 metres, was added. Work has now been begun on the erection of a more powerful transmitter near Bangkok. It will be rated at 100 kw. Six studios and three announcers' booths are to be installed in a new General Post Office building included in the scheme.

The language problem should not prove a bar to trade, for English is widely used commercially, and it is only in bazaar work that a knowledge of the national tongue is necessary. While, by comparison with other overseas markets, Thailand is as yet only small when considered from the electrical exporter's point of view, it is a market which will undoubtedly expand in the next few years.

FREEZING AND COLD STORAGE OF FISH

A REPORT from the California State Fisheries Laboratory* claims that the problem of preserving tuna on fishing voyages of several weeks duration, in good condition for canning, has been solved—at least on a small scale—by the application of freezing and cold storage. This announcement may serve as a reminder that the problem of so improving the preservation of fish at sea as to reap the full benefit of the ever wider extension of fishing made possible by the construction of larger, more speedy and generally more efficient catching vessels, is also a pressing one in Europe, and that its solution by freezing and cold storage has been repeatedly advocated of recent years by the Food Investigation Board on the basis of work done at the Torry Research Station, Aberdeen.

While most modern British fishing vessels successfully undertake voyages lasting three weeks or even longer, some reaching to well within the Arctic Circle, the universally employed means of preserving the fish, namely, storage in crushed ice, have in such circumstances proved inadequate, with the result that a considerable proportion of the total catch is landed in poor condition. Ice, in fact, will normally preserve white fish in really fresh condition for little more than one week. Freezing, on the other hand, promised not only to avoid staleness in long-distance fishing but also, if cold storage were continued on shore, to steady available supplies of the various food fishes independently of seasons and circumstances. Research has clearly shown that fish of all sorts can be kept in a condition practically as good as freshly caught for several months—even for much longer in the case of most white fish—if certain technical principles are observed. The fish must be frozen while strictly fresh and stored at temperatures in the range $-20°$ to $-30°$ C. In addition, freezing to these temperatures should preferably be completed within two or three hours. Only by employing such low temperatures is it possible sufficiently to retard various types of deteriorative change affecting odour, flavour and texture†.

The poor quality of the relatively small amount of fish frozen annually in the past must be held responsible for such prejudice against frozen fish as now exists. There appears to be little doubt that these fish were frequently frozen when already stale, and they were certainly stored at much too high temperatures, for example, $-6°$ to $-10°$ C., besides being as a rule very slowly frozen.

Unless a shore station can be established very near abundant fishing grounds, as, for example, in eastern Canada or Iceland, or in Great Britain with respect to the herring fishery, it is necessary to freeze the fish on board ship. A large factory ship with an attendant flotilla of small catching vessels could range remote seas for months at a time; alternatively, a super-trawler fitted to freeze and store as well as catch fish could operate nearer home for periods of some weeks. The former scheme has already been tested by British enterprise and the latter by French; and with return to peace conditions it is to be hoped that these pioneer attempts will be followed up, and that eventually Great Britain may be assured at all times of a steady supply of all kinds of fish of uniformly high quality. It is of present interest to note that part of the shortage in the home supply occasioned by the War is being met by the import of frozen fish; but it is well also to remember that at such a time considerable difficulties may frequently stand in the way of treating the fish in the best possible manner.

GEO. A. REAY.

* The Refrigeration of Tuna. Progress Report No. 2. (California State Fisheries Laboratory, Terminal Island, California.)

† See Reay, G. A., "The Freezing and Cold Storage of Fish", *Modern Refrigeration*, July 18, 1940.

RESPIRATION IN THE HIGHER PLANT

Aerobic breakdown of sugars can conveniently be studied in two stages—glycolysis followed by oxidative processes. Both phases have been discussed recently (*New Phyt.*, **39**; 1940). James and James (*loc. cit.*, p. 266), continuing the work on pyruvic acid metabolism, have shown that inactivation of carboxylases in barley, either by acetaldehyde or by one of a number of aromatic sulphonic acids, leads to accumulation of pyruvic acid in amounts which enable the isolation of identifiable hydrazones. The position of pyruvic acid in the aerobic respiration of barley is now considered sufficiently clear by James and his collaborators to allow the statement of a chain of reactions involving ascorbic acid oxidase:

$$\text{hexose} \xrightarrow[1]{} \text{hexosediphosphate} \xrightarrow[2]{} \text{triosephosphate} \xrightarrow[3]{} \text{phosphoglycerate} \downarrow \text{pyruvic acid.}$$

Reaction 3 involves the oxidase. Pyruvic acid is metabolized to acetaldehyde and carbon dioxide in the usual way, though it is considered that the former may not be respired directly in young tissues, but may rather be concerned with synthesis (Report of Soc. for Exp. Biol., *loc. cit.*, p. 335). The oxidative stage in plant respiration involves one or more of a series of enzymes.

In a review of the various possibilities Boswell and Whiting (*New Phyt.*, **39**, 241; 1940) discuss the three principal oxidase systems and also other systems of less importance. They base their study on the observation of Szent Györgyi that only catechol compounds, ascorbic acid, and dihydroxymaleic acid give a pronounced violet coloration with ferrous salts in neutral solution. For example, in catechol, an iron-catechol complex is formed, and this, by electronic interchange between Fe^{++}, $C_6H_4O_2^{--}$ and Fe^{+++}, eventually releases free orthoquinone. Catechol oxidase is considered to act simply as a copper compound effecting oxidation by such complex formation, oxygen addition, and electron transfer. The importance of the three compounds listed above seems to lie in the fact that each carries a dihydroxy grouping. Oxidases may thus be regarded as protein plus firmly attached metal plus loosely attached prosthetic group or coenzyme containing a dihydroxy group. The chemical possibilities underlying oxidation by catechol oxidase, dihydroxymaleic oxidase, and ascorbic oxidase are discussed in some detail.

There is, however, no clear evidence that these last two are widely operative in plants. The more important catechol oxidase contains no peroxidase; it produces quinones, which act as hydrogen acceptors, and perhaps also hydrogen peroxide which is removed either by catalase or peroxidase. Among other iron complexes, the iron-porphyrins cytochrome and peroxidase receive most attention. The latter is stated to catalyse oxidations in the presence of hydrogen peroxide only. It may thus play a part in the catechol oxidase system by increasing the production of quinones. It is suggested that the respiratory chromogens of Palladin may be prosthetic groups loosely attached to unknown proteins.

NEW WORLD POPULATIONS

Raymond Pearl has examined statistics of the populations of the western hemisphere, the New World, in relation to corresponding figures for the Old World, so far as available, and taking certain bases of comparison as indexes of 'youthfulness' or the reverse in the populations compared (*Human Biology*, **12**, 3; 1940). Five of six attributes of populations generally regarded as of primary importance have been taken, the sixth quality being omitted on account of the difficulty of scientific appraisement.

(1) *Density of aggregation per unit of land area.* Central America, 37 persons per sq. mile; North America, 17 per sq. mile; South America, 12·8 per sq. mile, as against Europe, 189·5 per sq. mile; Asia, 108·6 per sq. mile (U.S.S.R. territory being omitted in both these). Broadly speaking, a relatively low density implies a comparatively youthful and vigorous stage of population.

(2) *Net percentage rate of growth per unit of time.* The comparative levels of population growth-rates may be taken as the clearest and least equivocal expressions of innate physical vigour, combining the forces of natality and mortality. The higher birth-rates are found among the biologically more vigorous, whereas in enfeebled populations the death-rates tend to be low. In such figures as are available from 1900 until 1935, the most impressive result is a well-nigh universal decline, but even so the population of the New World is growing at a much faster rate than that of Europe. The figures available are: Europe, 1900–10, 0·95 per cent; 1910–20, 0·22 per cent; 1920–35, 0·81 per cent. Western hemisphere, 1900–10, 2·24 per cent; 1910–20, 1·72 per cent; 1920–35, 1·68 per cent.

(3) *The natural rate of increase by excess of births over deaths.* This gives insight into the capacity for growth and general biological healthiness of a population at a given time. Figures for 116 countries are considered and again confirm the general biological healthiness of New World populations. The average vital index for the western hemisphere is 175·72 as against Europe 151, Asia (sampled) 152, Africa (sampled) 162, or a grand average for the eastern hemisphere of 152·38.

(4). *Age composition.* This attribute is of vital importance as reflecting the mass outlook on life and the psychology generally, as populations containing a relatively high proportion of young people are apt to display progressive and hopeful attitudes and to be aggressive in social and economic pioneering. Taking the life-cycle as falling into three divisions, the figures for the western hemisphere are: pre-reproductive, 39·0 per cent; reproductive, 50·6 per cent; post-reproductive, 10·4 per cent. For Europe, pre-reproductive, 27·9 per cent; reproductive, 52 per cent; post-reproductive, 20·1 per cent.

(5) *Racial composition.* As applied to the western hemisphere, just under 65 per cent of the combined total population is classified or regarded as white without other racial admixture.

RESISTANCE WELDING

WHAT may seem at first sight unlikely subjects can often be treated by resistance welding by carefully anticipating the conditions. Each welding possibility must be considered on its merits and not crippled by attempts to improvise a solution from a standard machine not suited to the special requirements of the case, and the advice of manufacturers should be sought.

The *Electrical Review* of November 15 shows what can be done in this way in a description of the Metrovick "A S P" heavy-duty spot welder; this machine is flexible enough to deal with light work also, and can be adapted for projection welding by changing the electrodes, which are bolted to top and bottom platens, for contact blocks. A 12-in. diameter double-acting cylinder provides a maximum pressure between platens of 9,000 lb. from air supplied at 80 lb. per sq. in. from reservoirs built into the top of the frame. Within the frame is a 250 kva. welding transformer having a secondary winding consisting of copper tube of square section brazed into cast copper headers through which the cooling water circulates. The primary has five tappings and a series-parallel connexion, all taken to a double-unit tapping switch on the frame giving a wide range of welding currents.

For straightforward projection welding, a contactor and timing device for controlling the duration of the weld have been found quite satisfactory. For more involved work, especially spot welding of heavy sections, the interrupted current method offers advantages. This method with 'woodpecker' control depends upon the employment of synchronous timing devices that allow instantaneous switching of heavy currents, as there is no inertia due to the moving parts, and permits the application of repeated and predetermined current impulses by a single operation. The use of interrupted current greatly lengthens the life of the electrodes when spot welding heavy sections, and so greater thickness of metal can be dealt with by any one machine. It is of advantage also on jobs that tend to 'flash' or blow out weld metal during the passage of the current. When spot welding thick pieces of steel together, the heat generated, combined with the high pressure applied to the electrode tips, tends to cause the material to anneal and the tips to 'mushroom' out and fuse to the steel. While the time between impulses allows the water flowing to the electrodes to control the temperature of their tips, the interval is insufficient for appreciable heat to be lost from the inside surfaces of the plates where the weld is being formed.

The control consists of an ignition panel for determining the welding current, and a small panel mounted on its side housing two thyratron-controlled relays for regulating the time at which set-up pressure is applied and the length of the forging period. The latter is the time of pressure 'dwell' after the weld is completed and before the electrodes are allowed to separate. A differential pressure is obtainable by electrically operated air valves, and the air can be exhausted underneath the piston at any desired stage of the cycle by means of the thyratron relay in order to apply a sudden pressure increase to the electrodes. This upset pressure is of considerable value in consolidating welds made in the thicker sheets and in obtaining a flush joint on projection welded assemblies.

FORTHCOMING EVENTS

Monday, December 16

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. E. A. Gunther: "Sierras of Venezuela".

Tuesday, December 17

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, London, S.W.1), at 1.30 p.m.—Mr. Alec George Vaughan-Lee: "The Mohammad Aly Barrages, Egypt."

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne), at 6 p.m.—Sir Stephen J. Pigott: "The Engining of Highly Powered Ships" (Sir Charles Parsons Memorial Lecture).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN THE DEPARTMENT OF PHYSICS AND APPLIED PHYSICS of the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (December 20).

LECTURER IN ELECTRICAL ENGINEERING at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (December 28).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1939, with Report of the Director of Fuel Research. Pp. iv+206. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [1311

Other Countries

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1930–1931. Part 1. Pp. ix+163. (Cairo: Government Press.) P.T.30. [511

Commonwealth of Australia: Council for Scientific and Industrial Research. Fisheries Circular No. 2: The Canning of Fish and Fish Products in Australia. By E. J. Ferguson Wood. Pp. 56. Pamphlet No. 100: Studies on the Marketing of Fresh Fish in Eastern Australia. Part 2: The Bacteriology of Spoilage of Marine Fish. By E. J. Ferguson Wood. Pp. 92. (Melbourne: Government Printer.) [511

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 133: A Soil Survey of the Mildura Irrigation Settlement, Victoria. By F. Penman, G. D. Hubble, J. K. Taylor and P. D. Hooper. Pp. 76. (Melbourne: Government Printer.) [611

U.S. Office of Education: Federal Security Agency. Leaflet No. 28: Education in the Union of Soviet Socialist Republics and in Imperial Russia—Selected References. Compiled by Severin K. Turosienski. Pp. ii+16. (Washington, D.C.: Government Printing Office.) 5 cents. [711

Proceedings of the United States National Museum. Vol. 89, No. 3093: Two New Anuran Amphibians from Mexico. By Edward H. Taylor. Pp. 43–48+3 plates. (Washington, D.C.: Government Printing Office.) [711

Proceedings of the United States National Museum. Vol. 88, No. 3090: Seven New Species and One New Genus of Hydroids, mostly from the Atlantic Coast. By C. McLean Fraser. Pp. 575–580+plates 32–33. (Washington, D.C.: Government Printing Office.) [1111

Field Museum of Natural History. Anthropological Series, Vol. 27, No. 2: Notes on Skidi Pawnee Society. By George A. Dorsey and James R. Murie. Pp. 65–120. 40 cents. Botanical Series, Vol. 22, No. 3: Studies of American Plants, XI. By Paul C. Standley. Pp. 131–218. 50 cents. (Chicago: Field Museum of Natural History.) [1211

Publications of the Observatory of the University of Michigan. Vol. 8, No. 3: A Self-Recording Direct-Intensity Microphotometer. By Robley C. Williams. Pp. 45–56. (Ann Arbor, Mich.: University of Michigan.) [1311

Rubber Research Institute of Malaya. Annual Report, 1939. Pp. 278. (Kuala Lumpur: Rubber Research Institute of Malaya.) 1 dollar. [1311

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology. No. 6: Items 4770–4868, April, May, June 1940. By Ernest A. Hodgson. Pp. 89–104. (Ottawa: King's Printer.) 25 cents. [1411

U.S. Department of Agriculture. Farmers' Bulletin No. 1850: The Armyworm and its Control. By W. R. Walton and C. M. Packard. Pp. ii+12. (Washington, D.C.: Government Printing Office.) 5 cents. [1511

NATURE

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Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

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Telephone Number :
WHITEHALL 8831

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FOOD SUPPLIES AND THE BLOCKADE

THE fact that there was a serious food shortage in Germany towards the end of the War of 1914–18 makes people more ready to believe rumours that already in this War the shortage of food in Germany and in German-occupied countries is so serious that it may soon paralyse the Nazi war effort. These rumours should be received with caution. In the two or three years before the outbreak of the present War, there were numerous statements suggesting that food shortage, financial difficulties and other internal troubles were acute and that there were signs of a breakdown in the economic system which would bring about the collapse of the Nazi regime.

Whatever the origin of these rumours, their effect was to deceive the world about the real military strength of Germany. In view of the suggestion that, on humanitarian grounds, the blockade should be relaxed to allow food to reach the people in occupied countries, it is of interest to review what happened in the War of 1914–18 and consider whether events in the present War will follow the same course, as many people are too ready to assume.

The Germans fostered the belief that their defeat in the last War was caused by the starvation of the civilian population through the Allied food blockade. The idea that the defeat of the German Army was due to the blockade on food was assiduously cultivated in Germany as a means of getting the people to believe that the Army had not really been defeated. The food blockade certainly helped. But its main help was probably in reducing the output of munitions, owing to the deterioration of the health of the workpeople. The German Army was at full fighting efficiency in the summer of 1918. The Hindenburg line was broken and the Army defeated because the accession of men and armaments from the United States had, for the first time in the War, made the military forces of the Allies superior to those of the Germans.

Nor as a matter of fact was the blockade the sole, or even the main, cause of the acute shortage of food in Germany. In the five-year period before 1914, Germany produced 80 per cent of the food she consumed. The blockade was never complete. Germany continued to receive food from neutral countries in Europe. The deficit due to the blockade might have been made good by increased home-production, saving in wastage and efficient distribution. The consumption of food in Germany among the civilian population fell not by 20 per cent, which would have been the fall necessary had there been a complete blockade, but by about 50 per cent. The acute food shortage was due to the sacrifice of food for war ends. Nitrates, which should have been used for fertilizers, were used for making explosives. About two million farm workers were taken from the land for military service or for work in munition factories, and horses were taken from the farms for the Army. Because of the diversion of the national effort from food production to war ends, food production fell. Thus, for example, the yield of grain fell by about 22 per cent and the yield of sugar by nearly 35 per cent.

Further, part of the food that was produced, especially fats and sugar, was used for making explosives. Consumption of fat fell from the pre-war level of $12\frac{1}{2}$ oz. per head per week to about 2 oz., and of sugar from about $12\frac{1}{2}$ to $4\frac{1}{2}$ oz. The starvation of the German people was thus due more to the decision of the German Government

to sacrifice food for war ends than to the blockade of the Allies. Then, as now, guns instead of butter was the policy. If the Allies had allowed food into Germany, the enemy would have been enabled to release a further part of the national effort from food production to war ends, or to use a greater proportion of the food available for making explosives. Lifting the blockade on food would have been almost equivalent to lifting the blockade on munitions.

It is very doubtful whether food shortage in Europe will play as important a part in this War as it did in the last. The building up of a food reserve was part of the Nazi 'military economy', established in 1934. Agriculture was organized to increase crops which give the maximum amount of food per acre and to adjust animal husbandry to give the maximum amount of human food for the feeding-stuffs consumed. The potato gives twice as much human food per acre as grain. Although Germany had a relatively large acreage of potatoes in 1939, an additional 15 per cent was asked for. This would provide roughly about six times as much potatoes per head of the population as the United Kingdom supplies. Reserves of grain and fat were built up. By April 1938, there was a reserve of 4 million tons of grain and by April 1939 the reserve increased to 7 million tons. Between 1933 and 1938, by developing home-production, the total supply of fat increased by 281,000 tons. But the increase was not consumed. In fact, the consumption of fat per head per annum fell from 58 lb. in 1932, before the Nazis came into power, to 55 lb. in 1937. The additional fat had either gone into reserve or, on Goering's plan for sacrificing butter for guns, been used for the manufacture of explosives.

At the end of the four-year plan, which adjusted agriculture to military ends, Germany may well have been nearly self-supporting in food with considerable reserves. Any depletion of reserves has probably been made up by food taken from the occupied countries. It is very doubtful, therefore, whether there is any food shortage in Germany, or at least any shortage likely to interfere with the war effort.

A consideration of the food position of Germany and of the countries now occupied makes it probable that the food supplies now controlled by the Nazis are sufficient to prevent any acute shortage if they are distributed according to needs. But the Nazis are likely to use their control of food to suit military needs rather than the nutritional needs of the people. Control of food can be used as a means of keeping conquered people in subjection. Although a sudden shortage of food among a previously well-fed people might cause revolt, a gradual deterioration in the diet is more likely to be accompanied by physical weakness, loss of courage and will-power and general apathy. People suffering from malnutrition and under-nutrition are easily kept in subjection.

It would be foolish to hope for a collapse of the Nazis in the near future owing to food shortage. It would be safer to assume that their present reserves will be sufficient to carry them on to the next harvest. It would be equally foolish to depend upon food shortage as a means of defeating the enemy next year or the year after. It is difficult to set limits to the extent to which food can be increased by modern agricultural science, provided there are sufficient fertilizers and labour. By exploiting to the fullest extent all the lands of Europe which they control and all the subject labour, and by arranging distribution to suit military ends, the Nazis may well be able to maintain the strength of the war machine unimpaired indefinitely.

If, as we believe, the Nazis can, by devoting sufficient effort to it, produce sufficient food to maintain the efficiency of the war machine, what is the value of the food blockade? A food blockade is a valuable part of our war effort because any food allowed into countries occupied by the Nazis enables them to withdraw an equivalent part of the effort devoted to food production to direct war ends, and to that extent increases their military efficiency. Further, although explosives are not made from food to the same extent as in the War of 1914–18, large amounts of foodstuffs are being used for making motor-spirits and for other purposes connected with the manufacture of war material. The lifting of the blockade on food would be equivalent to the return to Germany of prisoners captured or the lifting of the blockade on petrol or other war materials.

There is evidently food shortage in unoccupied France, and there may be some degree of shortage in some of the occupied countries; but to what extent it exists it is difficult to assess. Travellers' tales are notoriously unreliable, and official news from the enemy is calculated to deceive rather than to inform. It is being suggested that food might be allowed through in sufficient amounts to prevent suffering among the people of the conquered countries. Even if food were allowed in,

there is no guarantee that the people would benefit. If the Nazis are unwilling to share the food they control with these people or even allow them to keep the food they have, it is very doubtful whether they would allow them to benefit from any food allowed in. Measures could, of course, be taken to ensure that the people received the actual food sent in, but there is nothing to prevent the Nazis, who have complete control, from withdrawing an equivalent amount of food either for the troops of occupation or for transfer to Germany. It has been suggested that dried milk and cod liver oil might be allowed in to prevent malnutrition, but the Nazis could take away an equivalent amount of dairy products.

The only way to bring relief to Europe is to defeat the Nazis and drive them out of the conquered countries. Anything which will contribute to the destruction of the Nazi war machine will contribute to the relief of the conquered people. Any food, or other material which can be used for war purposes, allowed into the part of Europe controlled by the Nazis, strengthens the Nazi war machine and, to that extent, delays the deliverance of the people of Europe. But preparations should now be made so that food and other forms of assistance may be rushed to these countries as soon as they are liberated. Attention should be given now to what foods will be most effective in rectifying the evil effects of shortage during the enemy occupation, and the organization for the transport and distribution of the food got ready.

The action which ought to be taken now and after the War should be based on facts and not on opinions formed from rumours and enemy propaganda. Until war broke out, there was an international committee of nutritional experts, including prominent American and British men of science nominated by their respective Governments. For three years before the War, this committee, in collaboration with a committee of economic and agricultural experts, was engaged in studying the food position in Europe. It would be better able to assess the true position and make recommendations than any other body which could be set up. Further, it had experience of similar work in advising on food relief measures for Spain. The United States and the British Commonwealth of Nations might well appoint the American and British members of this committee, with an American chairman, to investigate the position and report on the present food position in Europe in so far as information is available, the means which ought to be taken to relieve distress arising from food shortage in Europe, and also on the economic and political measures which should be taken to base post-War world food policy on nutritional needs. In its pre-War studies, this committee found that the basing of food policy in the nutritional needs of the people would, in addition to bringing about a great reduction in disease and a rise in the standard of living, bring prosperity to agriculture and increase international trade. The committee suggested could make sound recommendations based on ascertained fact to deal with the present position, and could also make an important contribution to the building up of the new and better world order we are looking for after the War.

Every means should then be taken to let the people in Nazi-occupied Europe know that the free countries are making elaborate preparations to bring food and other forms of assistance as soon as the Nazis are defeated. The knowledge that these preparations were being made on the recommendation of a committee of scientific men, all of whose names are well-known in every country in Europe, would help them to endure the evils of their temporary bondage and encourage them, at the appropriate time, to assist in their own deliverance.

TRADITION IN A NEW WORLD ORDER

WE live in the birth-pangs of a new world. Of what order that world will be now hangs on the arbitrament of war. Should the final decision be, as we hope and confidently expect, in favour of Great Britain and her Allies, to them will fall the task of moulding the new world in that shape which the ideals and principles for which we have taken up the challenge of dictators and totalitarian States may best be given practical effect. The burden will be heavy; and not the least onerous part of the task will be how best to ensure that in the endeavour to attain a state of permanent peace in the future by bringing about co-operation between peoples and nations in all matters which pertain to the common interests of mankind, loyalty to these principles and ideals

may be maintained without impairing either sense of freedom in action or individuality. At the close of the War of 1914–18 it is true that these elements of freedom and individuality were stressed over-strongly. The rights of minorities and the claims of the smaller national groups to self-determination were allowed to obscure the larger issue. This was largely a consequence, perhaps inevitable, of conditions which had preceded that great struggle. But when the time came for the League of Nations to take the strain, instead of a united team it proved to be rather an assemblage of disruptive forces in which sovereignty and national self-interest acted as the motive power and obscured the urgency of adherence to a common aim. The tradition of national and racial groupings, in the long run, rendered impotent attempts to secure full corporate action on the occasion of any major political crisis. A world which was to be "made safe for democracy", in the event, through the assertion of national claims in both the political and the economic spheres, became the opportunity of the dictator and of those whose specious arguments even in non-totalitarian States placed a delusive efficiency in public affairs above free discussion. In the result, democracy has been brought within measurable distance of the danger of extinction.

Many writers over a long period of years have prophesied the coming of Armageddon, when man would destroy himself and the civilization he has constructed by misuse of the powers of his own intellect and his control over the forces of Nature. Among recent writers Mr. H. G. Wells, in some of his early works, has drawn horrific pictures of a derelict world after the last great struggle has been fought to a finish. On the other hand, others, among whom Sir Arthur Keith has been conspicuous, have seen in war a moulding force by virtue of which racial, or rather national, types and characteristics are evolved. Without accepting the argument as valid in its entirety, it may at least be admitted that as a result in part of conditions arising out of the War of 1914–18 three new forms of political organization emerged—the League of Nations, the Russian Union of Soviets, and the British Commonwealth of Nations. Each of these was, in its respective method of approach to the problem of uniting a number of peoples in a single grouping, a step forward along the line of development of ever-increasing social and political units which is apparent in the evolution of human societies. Of the third of these, however, the British Commonwealth of Nations, it is perhaps not over-hazardous to say that it possessed the best chance of survival as being the least counter to tradition. It is in harmony with the trend of British institutions which have fostered local autonomy, not only in Great Britain itself in its municipal, district and county administrative bodies, but also in the legislative councils which hitherto had been responsible under the Imperial Government for the affairs of the Dependencies. At the same time the British Commonwealth stands alone in the history of political institutions in that it is a body composed of free and independent nations, in which any act of aggression of one member against another is well-nigh inconceivable.

The League of Nations was the latest of attempts since the *Pax Romana* and the Roman Empire to unite the peoples of Europe, or the greater number of them, in a single system. It differed from its forerunners in that it did not aim at complete political unity, but only at joint and corporate action in certain spheres of political, social and intellectual interest; it went outside the geographical boundaries of Europe and appealed for the co-operation of peoples of European civilization; and, most significant of all its differences from previous systems, it was based upon the voluntary principle and a degree of abrogation of sovereignty, and not upon force. It is, therefore, perhaps no matter for surprise that its most conspicuous success was precisely in those fields of activity in which before the first world war, interest, activities and joint action had been international and the barriers of national interests had been least operative—the field of the arts, sciences and social reform. In this respect it came near to reconstituting the international position of learning and the arts in Europe before the Reformation.

The fate of the League of Nations was a clear indication that the times were not yet ripe for so great a break away from the nationalist tradition. It has required the shock of a second world war and the imminent peril of free institutions throughout the world to bring once more into the field of practicable discussion the possibility of finding a basis of corporate action between nations which will ensure conditions of enduring peace. We may learn this lesson not only from America, where the President of the United States is urging upon peoples of very different civilizations in North, Central and South America, the necessity of a measure of common action in the interests of their common devotion to the ideal of political

liberty, but also from the aims of our adversaries. They too, Germany in Europe, Japan in the East, are formulating a political system which transcends national distinctions, but under the dominance of a ruling caste—a reversion, it is to be noted, to the system of barbarism which in European history followed on the period of migrations rather than a step forward along the line of what has been noted as evolutionary social development. German dominance, however, in the occupied territories and in the countries subordinate to the Axis contrasts, to its disadvantage, with even the darker period of the Middle Ages in the complete repression of things of the spirit and the eradication of all freedom of thought by the suppression of universities, schools and centres of learning which are not prepared to follow the paths marked out by political expediency.

Over against this spreading cloud which seeks to blot out every path leading to the development of the spirit of man, there stands Great Britain, her Allies and every free people which holds fast to the ideas of democracy, even though they may not yet go all the way with the United States in giving Great Britain every aid short of war. The aim of those who fight for the cause of democracy is not merely to ensure a lasting peace, but also that it shall be a peace in conditions which are a guarantee of the continuance of free institutions, and for the individual the fullest opportunity for the development of his character and capacities. This cannot be stated too emphatically or too frequently. In this connexion attention may be directed to a volume of speeches by Lord Halifax* in which implications of the democratic ideas as a political principle are set forth with wholly admirable lucidity and force. These speeches dealing with foreign affairs and the principles of British foreign policy were, many of them, though not all, delivered in the course of debate in the House of Lords, and the editor has provided a summary of events leading up to each speech. Hence this volume may serve as a useful reminder of the course of events in the most fateful years of the history of Great Britain. Not only do they carry great weight in their more general passages dealing with political practice and theory, but also they have special authority in the later years when Lord Halifax speaks as the Secretary of State for Foreign Affairs and the spokesman of the Government in the House of Lords.

* Speeches on Foreign Policy. By Viscount Halifax. Edited by H. H. E. Craster. Pp. x+368. (London, New York and Toronto: Oxford University Press, 1940.) 10*s*. 6*d*. net.

It is especially illuminating to recall the course of events and to note here how from faith in the League of Nations and collective security with a conciliatory attitude towards Germany, the Government passed through a phase of increasing distrust of the Nazi regime and misgiving as to the efficacy of the League, a period of regional pacts and so-called realism in international relationships and finally to complete disillusionment. Throughout, however, Lord Halifax stands fast by the ideal of democracy, from the time when in 1934, in addressing the educational section of Messrs. Rowntree's factory at York, he defined the object of government as "the fuller and freer development of human life" down to the latest speech here included, "The Challenge to Liberty," delivered at Oxford in February 1940, when he contrasted the spirit of German youth and British youth and defined British policy in the War as resting upon twin foundations of purpose—"determination to resist force" and "our recognition of the world's desire to get on with the constructive work of building peace"—the latter, as he had shown, a task which must be pursued in the Christian spirit of tolerance and justice.

While it is generally agreed that in a post-war settlement which aims at conditions of enduring peace it will be essential to bring about some form of co-operative or federal organization at the very least in Europe, it is obvious that to translate the democratic ideal into a working system presents many grave difficulties. Many practical problems have to be solved, some of which have already been discussed in the columns of Nature. Of these, in a democracy, education on rising standards possibly comes first, but hygiene, unemployment and inter-State relations in exchange of commodities and in finance run education close. If we may learn from our adversaries, the *ostensible* uniformity of the system of finance and commercial relations proposed in the Nazi 'New Order' merits examination. So far as these problems approach solution so far will the task of the central organization approach fulfilment, but in both spheres, that of the practical problem and that of the affairs of the whole organization and of its relations with those outside its body, successful working will come not by the elimination of national and cultural differences, as many fear, but by their recognition and by the preservation of those forms of cultural tradition which by their very differences lead, as the history of civilization shows, to cultural advance.

THE FUTURE OF COLONIAL POLICY

THE uncertainty of the reaction of the Vichy Government to German plans for obtaining control of French West Africa has already excited alarm, not only in Great Britain and in the United States, but also among the African peoples. It is not merely the strategic issues involved that arouse concern. With the shattering, at any rate for the time being, of Anglo-French co-operation in colonial administration and development, there has come a real threat to the new and liberal ideas of trusteeship embodied in the mandate system. These fears are unlikely to be allayed by the new co-operation between France and the Axis powers, whatever form that co-operation may take.

Nowhere indeed is the contrast between the Axis powers and Great Britain more marked than in the field of colonial policy. The rule of the Axis in Africa as elsewhere would mean the subjugation of the native populations to the needs and demands of Germany and Italy, the exploitation of their resources and people in the interests of the white races alone—the complete negation of the mandate principle and a reversion to the old, evil imperialism from which Africa has slowly emerged.

There have indeed been marked differences between French and British policy, but whatever these differences, the experiments and reforms either discussed or introduced down to the fall of France all reflect the view, common to both the French and British Colonial Empires, that the native is to be treated as an end in himself, a person to be associated in one form or another with the development and administration of his country. Whereas Anglo-French co-operation in this field has been interrupted, Britain's loyalty to the principle of trusteeship remains unshaken, and indeed is reaffirmed in the developments proceeding under the policy announced by the Colonial Secretary early in the year in the Statement of Policy on Colonial Development and Welfare.

This factor may not be without some influence on the situation in Africa and on the course of the war. The Vichy Government has already aroused too much alarm in the French Colonial Empire for it to risk further alienating native opinion and support. Indeed, the whole French tradition of colonial administration is one which should make the task of General de Gaulle and the Free French forces of winning the support of the native peoples at least throughout that Empire relatively easy. The importance of wise and far-reaching propaganda should not be under-estimated, above all if it is supported by administration of the territories under the rule of Free France and of Great Britain of a type calculated to hold and encourage the loyalty of the native peoples, whose desire for a British victory has indeed already received striking demonstration.

The tactical importance of the developments in colonial policy foreshadowed in the White Paper is far from being generally realized. The practical applications of the principle of trusteeship outlined there, if wisely implemented at the present time, may even have a decisive strategic effect on the war in Africa, if it enlists fully the loyalty and enthusiasm of the African peoples. Sir William H. McLean's admirable review of the proposals and their import in his Cantor Lectures on the "Social and Economic Development of the British Colonial Empire", recently published in the *Journal of the Royal Society of Arts* (87, 871–881; 891–914; 1940) is a timely contribution which should assist in the general understanding of what is involved.

Apart altogether from tactical or strategic questions, the colonial problem has several other aspects which give it special importance at the present time. It is in the first place one of the major issues which is bound to be raised at the peace settlement. In any attempt to deal with the real causes of the present War, the question of access to raw materials will require reconsideration, and this question can scarcely be separated from that of colonial policy, administration and development.

It is fair to say that the sub-committee of the League of Nations and the Royal Institute of International Affairs have already carried out the requisite inquiries as to the facts of distribution of raw materials, and a number of important suggestions or recommendations regarding access to such materials have already been ventilated. In this sense the matter might well be regarded as in an advanced state of preparation for consideration as part of a world settlement leading to a new order after the War. Whatever specific form that settlement may take, there can be no doubt that the implementing of such a policy as that outlined in the White Paper, and the firm

establishment and enlightened administration of the Colonial territories during the War in the spirit of trusteeship, would go far to create an atmosphere of confidence and respect essential to a settlement reconciling the claims of all races involved.

The plan outlined by the late Sir Arnold Wilson in an appendix to "More Thoughts and Talks" (Longmans, Green and Co., 1939) for a system of pooled trusteeship, in which all the African colonies were gradually pooled in such a manner as to make them serve the common good both of the white races and of the natives, deserves close study and careful consideration. It offers advantages in gradual application, without transfer or decision of sovereignty for a generation, thus affording time essential to the education of public opinion for the idea of colonial trusteeship.

Schemes of this nature involve both careful investigation and equally thorough educational work. Both alike must be put in hand now if the colonial problem is to assist and not handicap the attempts and plans for post-War reconstruction. The value of the recommendation of the Hailey report for the establishment of an African Bureau has indeed been enhanced by all that has occurred since the findings of the African Survey were published in the autumn of 1938.

There is, however, a further and equally important respect in which the colonial questions are linked up with the problem of post-war reconstruction. The importance of the economic aspects of such construction have been repeatedly stressed, both in relation to a war strategy of organizing relief foı Europe as soon as the Nazi tyranny is overthrown, and as part of a wider scheme of settlement and economic development which would aim at raising the general standard of nutrition and living in the whole continent, but especially in the more backward parts of eastern Europe. In both of these, colonial questions and resources may play a large part.

In the first place, there must be a review of outside sources, including the colonial territories, from which the deficiencies in the distressed countries can most easily be met. This will include the building up of surpluses not only in the Americas but also in tropical Africa. Besides those of cocoa, palm kernels, groundnuts and other human foodstuffs, animal foodstuffs and other raw materials must be included, some of which, such as cotton and jute, will also be required by post-war Europe. Moreover, as Dr. Julian Huxley has pointed out, not all surpluses can be stored as such; some require processing, notably the vegetable oils. Such processing may involve the purchase of suitable machinery from countries the industry of which is not overtaxed by armaments production and, like the provisions of storage facilities, should form part of a comprehensive plan. This again may powerfully affect the economic situation in tropical Africa, where indeed it may already be necessary to buy up the surpluses if the local producers are not to starve. Such purchasing must also be done at a fair price if inroads are not to be made on the educational and social services of the territories in question.

To buy merely to destroy would be a poor answer, both to the propaganda insinuating that we are responsible for shortage in the countries overrun by the Nazis, and to their plans for the economic reorganization of Europe. The plans already envisaged by the British Government for the building up all over the world of food reserves destined for the relief of Europe may well make as important a contribution to the economic welfare of the colonial territories as to the defeat of Germany, the countering of German propaganda, and to laying the basis for a stable post-war world. The provision of proper processing and storage facilities could be made the basis of greater stability in primary production, by providing large-scale reserves functioning as buffer pools.

Such considerations alone emphasize the importance of the economic developments envisaged in the Statement of Policy issued last February. It is only on a secure economic foundation that schemes of social advance can be planned and carried out continuously. The lack of secure markets in the past has been the main cause of suffering to the people in some Colonies; they were unable to sell their produce and had to lower their standard of living in spite of the efforts of the Colonial Government to safeguard that standard. The real problem of raw materials, as Mr. H. D. Henderson remarks in "Colonies and Raw Materials", is that of securing a square deal for the primary producer. The first emphasis in the enlarged policy of Colonial development is accordingly on the improvement of the economic position of the Colonies. The arrangements for increased assistance from the funds of Great Britain, while related to what the Colonies can do for themselves, are intended to facilitate full and balanced development, and to place Colonial

Governments in a position to maintain administrative, technical and social services at proper standards. They are intended to ensure the adequate financing of the research and survey work, the schemes of major capital enterprise, and the expansion of administrative and technical staffs which are essential for full and vigorous development, as well as the maintenance of an adequate standard of health and education services.

There is already much evidence that malnutrition is a factor in ill-health and inefficiency in many parts of the Colonial Empire. According to the report of the Committee of the Economic Advisory Council on "Nutrition in the Colonial Empire", malnutrition there is due first to a low standard of living; secondly, to the great ignorance and prejudice both as regards diet and the use of land; and thirdly, to the influence of diseases, particularly the widespread parasitic infections in the tropics, which react upon the state of nutrition of the individual. Improved nutrition depends largely upon economic development, and in the Colonial Empire this means primarily an improvement in agricultural development. Accordingly, in agricultural policy, the nutritional needs of the community are of first importance, and the report urges that the aim should be the establishment of a balanced agriculture for the production of commodities to be used either for direct consumption by the producer and his family, or for sale for consumption elsewhere in the territory, or for sale in overseas markets. Colonial Governments should encourage the people to grow at least a part of the foodstuffs they consume and endeavour to improve colonial dietaries by increasing the quantity of foodstuffs consumed and by increasing the variety.

It is not in eastern Europe alone that developments, designed to raise the standards of nutrition and living generally by relieving economy of some of its excessive dependence on primary products, may assist in raising standards of living and increasing social and economic stability elsewhere. Policies of social development undertaken to raise the standard of health and nutrition in the African Colonies, with their repercussion on the standard of living in those countries, should provide the same expanding market to the industrialized nations that the developments suggested by Mr. McDougall would provide in eastern Europe. The developments advocated by Lord Hailey in regard to research and adopted by the Government in the establishment of a Colonial Research Advisory Committee and in the allocation of a separate sum for Colonial research, have a direct bearing on the new order to be established in Europe, no less than in Africa.

It is indeed reassuring that such developments should be encouraged by Government action during the present struggle. Further co-operation in the study of agriculture and husbandry, of soil erosion, or of transport needs, the pooling of information about the methods used in checking the diseases to which the African is prone and for dealing with the widespread malnutrition that exists, may prove indirectly almost as valuable a contribution to the solution of some European post-war problems as directly to those of Africa itself. The prosecution of research into African problems on an adequate scale and the keeping up to date of the admirable African Survey may offer a most important contribution to reconstruction, possibly even to peace itself.

The developments at present contemplated are intended to facilitate the long-term planning which is a *sine qua non* of effective research in many such fields. Moreover, the emphasis thus placed on the economic development of the colonial peoples, the protection and raising of their standard of living, and their social development and training for self-government, should ensure that the position of the Colonies is viewed in all its issues at an international settlement. It affords unmistakable evidence that the principle of trusteeship is sincerely accepted and loyally fulfilled. It attests our capacity to shape within our own commonwealth at least our own form of co-operative society—in Mr. Herbert Morrison's words: "A free partnership of freely active groups, in which there is no room for mutual attempts at exploitation or for sharply differing levels of social and economic opportunity." Recognition of our responsibilities for the physical and moral welfare of these peoples and a determined effort to honour our trust are in such sharp contrast to all that has been revealed of the German attitude to such questions, of which the exclusion of the native peoples on principle from higher schools and universities enunciated by Dr. Gunther Hecht in "The Colonial Question and Racial Thought", is only one illustration that it can scarcely fail to enlist the loyalty and support of the native peoples of the African territories in a way which should effectively counter the consequences there of the collapse of France.

ELECTRIC AND MAGNETIC UNITS

M.K.S. Units and Dimensions and a Proposed M.K.O.S. System

By Prof. G. E. M. Jauncey and A. S. Langsdorf. Pp. viii+62. (New York: The Macmillan Company, 1940.) 4s. net.

A VERY large number of conferences has been held in recent years on questions connected with electric and magnetic units. Most scientific workers are content to use the units without discussing them, and have probably been relieved to find that in spite of many weighty pronouncements there has been no very noticeable change in current usage. There is, however, a vague idea abroad that important changes took effect in January 1940, and one of the objects of this book is to introduce to students the new position, the authors adopting the view that this is represented by the M.K.S. system.

The general situation, however, remains a little obscure. Some years ago the International Bureau of Weights and Measures announced its intention of abandoning the present International units, based on the silver voltameter and the standard column of mercury, and adopting units based on the absolute system. In practice, this would have meant that the familiar units, the ohm, ampere, volt, joule, watt, henry, and farad would have had their values adjusted to the extent of a few parts per 10,000. These changes, which were to have been made in January 1940, would have had legal backing, but, owing to the War, no action was taken and the International units still remain in force.

The decisions of the other conferences were on quite a different footing. The International Union of Pure and Applied Physics, and the International Electrotechnical Commission, made recommendations to physicists and electrical engineers respectively. The physicists were recommended to adopt the gauss, oersted, maxwell and gilbert as their magnetic units, and the C.G.S. system generally, while the engineers were recommended to use the weber as their magnetic unit, and the M.K.S. system generally. The physicists afterwards recognized the M.K.S. system as a tolerable modification of the C.G.S. system, and both physicists and engineers decided by majority votes that magnetic induction B, and magnetic force H, should be regarded as quantities of a different kind, and that therefore permeability (and permittivity or dielectric constant) should be regarded not as mere numbers but as quantities having dimensions.

The possible effects of these decisions on scientific workers is a matter of some importance. Will they in fact follow the recommendations of the conferences? A first glance at the literature of the last five years suggests that they will not; that they will continue to use the units to which they are accustomed. The September issue of the *Proceedings of the Physical Society*, for example, contains an account of a recent discussion in which the recommendations were attacked at least as frequently as they were supported. Mr. C. R. Cosens deplored "the redundant names of units", which "appear to be largely by-products of the labours of International Commissions", and Dr. Burniston Brown proves that μ and ε are pure numbers, as they certainly are if one accepts his definitions of B and H, which are at least workable. However, it does not follow that other concepts are unworkable. As Prof. Henri Abraham pointed out, as president of one of the conferences, "une question d'opinion métaphysique" is involved. Clearly such questions will not be decided by any fixed date. The final decision, if there is one, must depend on the experience of those who use and teach the concepts, and will probably rest largely with the university professors.

In this connexion this small volume by two American professors, one of physics and one of engineering, is of considerable interest. It is one of the very few signs which suggest that the M.K.S. system has made a little headway, and that physicists and engineers may ultimately agree to abandon the curious assortment of units which they now use in favour of a single system. For the most part, the book is a clear, straightforward exposition, suitable for students new to the subject, of the point of view implied by the decisions of the various conferences, although the authors express disapproval of the one decision which would have had legal backing, namely, the adjustment of the value of the ohm. They support the view, which has already been advocated in several quarters, that since even in an absolute system one electrical unit must be regarded as a primary unit on the same footing as the metre, kilogram and second, then for reasons of practical convenience in the preservation of the primary units, that unit should be the ohm, which should remain fixed in value, just as the kilogram and metre remain fixed, in spite of the failure to give them the values origin-

ally intended. The treatment of the M.K.S. system follows mainly the lines laid down in the pioneer work of Giorgi and G. A. Campbell, but whereas these writers would advise the student not to waste his time over superfluous systems like the two C.G.S. systems, the present authors outline all the systems. It may be doubted whether students will welcome the M.K.S. system merely as an addition to the others.

B and H are presented as quantities measured in different ways, and therefore of different dimensions. Some readers may doubt whether there is an inevitable connexion between the nature of a quantity and its dimensions, but the subject is skilfully expounded. The student is shown how the ideas work by a series of theoretical experiments, and even if the ideas may afterwards require overhauling, the book forms a good introduction to the subject.

L. HARTSHORN.

SEXUAL DISPLAY IN BIRDS

Courtship and Display among Birds
By C. R. Stonor. Pp. xv + 140 + 57 plates. (London: *Country Life* Ltd., 1940.) 8*s*. 6*d*. net.

AS is well known, the term 'sexual selection' was originally used by Darwin in two senses: first, with reference to the evolution of weapons like horns in ungulates and spurs in birds, such structures rendering their male possessors more efficient in combats for the mastery of the females with which they desired to mate; and secondly, in relation to decorative features possessed by the males and thereby making them more attractive to the female, which was supposed to exercise a preference towards mating with such males. The former process, as freely admitted by the earlier Darwinians, did not differ in principle from any other type of natural selection; but about the second there has always been much dispute.

Wallace, who based his conclusions largely on field observation, but partly on deductive reasoning, denied its existence in Nature, and other field naturalists have done the same. Mr. Pycraft in his book on the "Courtship of Animals" published in 1913, while saying that the theory of sexual selection was by no means exploded, was one of the first to give it a new interpretation. This he did in a way which now has the approval of many other zoologists, saying that the utility of the display and of the ornamentation which is correlated with it is to quicken desire in the individual to whom the display is directed, or, as he expresses it, that it has a sort of aphrodisiac action. According to this view, which was reinforced by the observations of Dr. Julian Huxley, sexual selection, wherever it occurs, must be a special case of natural selection, a conclusion which was arrived at on slightly different grounds by Sir John Graham Kerr. Of the many objections to the Darwinian theory of sexual selection the most cogent is one that oddly enough does not appear to have been urged until comparatively recently, namely, that sexual display is very usually performed by birds after they are already mated and cannot, therefore, have any connexion with any supposed preferential choice on the part of the female. There is, however, evidence that selection may take place with the ruff and the blackcock, as the late Edmund Selous has shown, as well as with some kinds of ducks.

In recent years there has been a convergence between the methods and results of field observation and those of physiological experimentation, and in no subject is this more marked than in the study of sexual behaviour. Researches into the comparative physiology of the generative processes as carried out in the laboratories have provided clues to the interpretation of animal behaviour as recorded by field naturalists, and there has been a stimulating reaction between the two kinds of study. This is well illustrated by such works as those of Mr. Eliot Howard and Dr. Fraser Darling, and the beneficial effects of such convergence are further shown in Mr. Charles Stonor's book on courtship and display. This is not saying that miscellaneous observations of natural occurrences in the field are not of value provided always that they are careful and accurate, and it is to be hoped that such studies, uncorrelated though they may be, may continue if only for the delight they afford to the watcher. Bateson some fifty years ago referred to such purely observational work as though it were a thing of the past: "In the old time," he said, "the facts of Nature were beautiful in themselves and needed not the rouge of speculation to quicken their charm, but that was long ago, before Modern Science was born." This is certainly not true of to-day, at least so far as bird watching is concerned. Nevertheless the æsthetic delight gained in this way is no whit depreciated by adding to it the intellectual pleasure of attempting to formulate a scientific hypothesis which co-ordinates and explains the facts.

In Mr. Stonor's very attractive book a definite physiological theory of sexual display and courtship is adopted and some of the evidence put forward and described. Such a theory had already been adumbrated by me in an article in Nature of October 26, 1929, but the evidence in support of it as derived from comparative physiological studies as well as from the observation of animals is now much more considerable than it was then. It is thus picturesquely described by Mr. Stonor. After referring to the pituitary gland as a kind of general prompter or activator of the other ductless glands, and as "the leader of the endocrine orchestra", he proceeds as follows: "The important point for us is that this pituitary body is known to be affected in a direct way by messages sent to the brain via the eye. So that when a Paradise Bird performs his dances, or a Peacock shows the dazzling magnificence of his train, the unusual and arresting sight he presents to the female, like the incomplete clutch of eggs (of which birds also show a physiological awareness), makes a strong impression on her eye, is flashed back to the brain and to the pituitary gland, which sends out its message to the rest of the body via the substance it secretes, to tone itself up and get ready for the breeding season," the ovaries being stimulated.

In the second chapter Mr. Stonor describes and compares the displays of two quite unrelated groups of birds, namely, the birds of paradise and the gallinaceous or game birds, and the probable evolution of the different kinds of display. He shows that whereas in birds of paradise variations in form and in display have gone hand in hand, in gallinaceous birds variation in form has largely outstripped the development of display. He concludes by stressing one outstanding fact, that "no matter where the special adornments of a bird may be situated, no matter what form they take, they are always combined and synchronised with one another to produce the maximum possible effect."

The next two chapters are upon mutual and communal displays, and instances are described from among many different sorts of birds. It is shown that with mutual displays one sex is very usually more active than the other, but this is not always so, for with the great crested grebe and the wandering albatross the female is every bit as active as her mate. Moreover, there are certain birds, such as the button quail, the tinamous and the New Zealand paradise duck, where the female is the active partner in courtship, and in some of these species the incubation and care of the young are left to the male. It is pointed out that in the case of communal displays, apart from the 'advertisement value' of the gatherings, the presence of a large number of birds which perform in common helps to key up and stimulate each individual male and female which visits the group. This is in accordance with the observations of Dr. Fraser Darling, who found that collective display in communities favours and accelerates successful breeding as a consequence of mass effect in stimulation.

The next chapter is on display grounds which, as the author shows, provide a suitable and conspicuous setting for the display, and suggests that though these areas may have become mainly 'recreational', they were originally solely for the purpose of courtship. Communal display is shown by the ruffs and reeves, the black game, the herring and other gulls and many different kinds of birds in which the practice has been independently developed. There are also other kinds of display, such as the threat display, but, as pointed out, the same kind may be used at different times for more than one purpose by identical birds.

The final chapter deals with the author's general conclusions. Here he compares the different kinds of display, and points out among other important matters that not "*all* bright-coloured birds have a brilliant display as the reason for their colours"; for example, the greens of the parrots, the bizarre colours of the fruit pigeons and the brilliant hues of the kingfisher. Another point of interest is that among species with no need for concealment while breeding, the sexes are generally similar, and with this similarity goes joint action in display; and even "where the male and female differ, the plain female often seems to be anxious, as it were, to imitate the male, and only held back by circumstances from becoming like him". These are only a very few of the important and interesting matters which are referred to or discussed in this chapter or in other parts of the work.

The photographic plates illustrating the book are well chosen and for the most part excellent. The only mistakes I have noticed relate to the references to some of these plates in the final chapter (p. 124 *et seq.*).

Mr. Percy Lowe has contributed an appreciative foreword and tells us of Mr. Stonor's qualifications —his biological training, his practical experience in the Zoological Society's Gardens, his work in the British Museum (Natural History) and his field experience. There can be no doubt that this exceptional combination of circumstances has helped the author to produce an attractive book which presents the facts in simple and, for the most part, non-technical language, and yet is full of information for the sexual physiologist and the specialist in bird behaviour.

F. H. A. Marshall.

CHEESE-MAKING: SCIENTIFIC RESEARCH AND CONTROL

THE oldest and one of the best ways of concentrating and conserving in a palatable form a large part of the nutritive value of milk is to make cheese of it. Whilst butter contains little more than the fat of the milk, cheese contains the casein, a large proportion of the valuable mineral salts and an important part of the vitamins as well. Only a relatively small proportion of the original water of the milk—approximately 2·5–3 per cent—remains in the ripened cheese, which if it is one of the more popular types of cheese in Great Britain, may be taken as containing about a third each of animal protein, fat and water. Cheese is probably, weight for weight, the most valuable of the ordinary foodstuffs in our dietary, since neither dried whole milk nor dried skim milk are purchased, nor readily purchasable, by the ordinary consumer in Great Britain. Approximately 200,000 tons of cheese, of which about twenty-five per cent was made in Great Britain, were consumed annually in this country before the War.

But there is cheese—*and* cheese. Unimpeachable organoleptic evidence exists for the statement that even under modern conditions cheese-making is not by any means a fully controlled industrial process. It is an art, as well as an "essay in applied biochemistry and bacteriology", and an art that sometimes breaks down seriously. Of late years, however, scientific research and control have made cheese manufacture less erratic.

At a joint meeting, under Mr. E. B. Anderson's chairmanship, of the Food Group of the Society of Chemical Industry and the Society of Public Analysts held in London on December 4, some aspects of recent research on cheese quality and its control were described by Prof. H. D. Kay and three of his colleagues of the National Institute for Research in Dairying. These investigations are a small part of an extensive programme of research on cheese-making and cheese quality that was getting under way at the Institute and at various co-operating cheese-making and other centres at the outbreak of war, and in which a fairly large team of research workers including a physicist, a statistician and a psychologist were collaborating. The War has inevitably interfered seriously with this plan; but a portion of the work, which has a direct bearing on cheese-making under war conditions, is still going on.

In an introduction by Prof. Kay this general plan was briefly outlined. Cheese is a complicated living system rather than a stable end-product, and a variety of techniques, chemical, biochemical, bacteriological, physical, physiological and psychological, are needed if the measurement and control of the many factors that go to make up cheese quality are to be satisfactorily effected. Methods for improved control of the quality of the original milk, of the cultures of lactic acid bacteria ('starters') added to promote acid production and flavour, of the enzymic characteristics of the rennet used, of the temperature and acidity of the milk and curd at various stages, of the timing of the succession of operations, of the physical properties of the curd and ripening cheese, are being considered. It is particularly necessary to define cheese quality so far as possible in precise terms, otherwise it cannot be consistently achieved.

Some recent findings on the nutritive value of various types of cheese were described in the introduction. Mr. J. Houston, who with Dr. S. K. Kon is investigating the proportion of the various vitamins of the original milk that remain in several staple varieties of cheese after different periods of ripening, has found that almost the whole of the vitamin A and carotene of the original milk remain in the cheese made from it, whether it is Cheddar, Cheshire or Stilton, and whether it is made in summer or winter.

It is not surprising that both these accessory factors, being fat-soluble, stay in the cheese, which contains practically the whole of the fat of the original milk; but it is of considerable significance that during the four to five months of the ripening process the conditions in the cheese are such that there is no destruction of either vitamin A or carotene.

Of the vitamin B group, preliminary experiments show that vitamin B_1 is lost in the whey to the extent of about nine tenths of that present in the original milk. Of the lactoflavin (riboflavin) distinctly less—only about three quarters—appears to go into the whey. On the supposition that these two vitamins are present in simple aqueous solution, it would be expected that more than 95 per cent of each would be lost. There is now little doubt, however, that a considerable proportion of each of these vitamins—particularly riboflavin—is more or less firmly bound to the proteins of the milk which are clotted by rennet. About 10 per cent of the B_1 vitamin in the original milk, and about 25 per cent of the lactoflavin remain, there-

fore, in the cheese, and suffer no serious change in amount during at least four months of ripening. If anything, Stilton contains a slightly larger proportion of the vitamins than the other two varieties.

Prof. Kay also brought forward some analytical work of Dr. E. C. V. Mattick by which she has shown that there is considerable variation in the content of mineral salts as between the commoner cheeses—Cheddar, Cheshire and Lancashire on one hand, and Stilton on the other. In the making of Stilton the curd is allowed to remain in contact with the whey for a longer time than in the case of the other three cheeses. As a consequence the Stilton curd is bathed in an increasingly acid medium (owing to the bacterial fermentation of the lactose which is still proceeding rapidly in the whey). As this increasingly acid medium slowly drains away it leaches out much of the calcium and phosphorus originally present in the curd. Whilst ripe Cheddar cheese, for example, contains 57 per cent of the calcium of the original milk and 50 per cent of the phosphorus, Stilton cheese of the same age and made from a portion of the same original bulk of milk only contains 7 per cent of the calcium and 26 per cent of the phosphorus. It is nutritionally of importance in war-time that each of the three most widely consumed cheeses—Cheddar, Cheshire and Lancashire—contains an equally high proportion of calcium. Stilton, a luxury cheese, is consumed for the most part by those whose diet is unlikely to be lacking in this mineral.

Flavour in cheese is bound up, to a large extent, with the presence of fatty acids, particularly the lower fatty acids, liberated during lipolysis. Miss E. R. Hiscox dealt with developments which she and her collaborators have introduced in the methods of determining volatile fatty acids in cheese, and with the significance of some of the recent findings obtained with the new technique.

Simple steam distillation of an acidified cheese mush gives results which are far too low, since both the fat and the protein of cheese hold back appreciable amounts of some of the volatile acids. Miss Hiscox gave details of a new method of analysis which depends on water extraction of the cheese mush, followed by extraction of the separated cheese fat with very dilute alkali, ether extraction of the residues and steam distillation of the acidified extracts. A particularly interesting finding is that the blue cheeses, Roquefort and Danish Blue, are in a different class from the blue cheeses Stilton and Gorgonzola as regards their content of fatty acids, and the behaviour of the fatty acids on extraction. The former pair are highest, Stilton and Gorgonzola lowest, in their volatile fatty acid content, whilst typical Cheddar and Cheshire are intermediate. The correlation between these and other findings and flavour of the different cheeses was pointed out.

The chief chemical changes in ripening cheese are proteolysis, fermentation of the remaining lactose to lactic, acetic and propionic acids, and a certain degree of lipolysis. Dr. J. G. Davis described the part played by enzymes in these processes. He stressed the importance, from the point of view of cheese quality, of beginning with chemically normal (that is, mastitis-free) milk, and with rennet of good quality. Pasteurization (which destroyed most of the enzymes of the milk as well as a large majority of the micro-organisms) previous to cheese-making slows down ripening and prevents the attainment of the fullest flavour. It also prevents the development of certain taints and aids in the production of cheese of long keeping quality. Commercial rennet contains enzymes having at least four distinguishable activities: (*a*) clotting, (*b*) proteolysis of the pepsin type (pH optimum of 2), (*c*) proteolysis of the papaïn type (optimum pH about 4·6), (*d*) proteolysis of the peptidase type (optimum pH about 6). Nevertheless, pure rennin free from pepsin produces equally good, if not better, cheese than commercial rennet.

Two of the enzymes which normally occur in raw milk—lipase and proteinase—are concerned in cheese-ripening. The latter produces a mellowing of the body of the cheese, owing to protein breakdown, but does not seriously affect the quantity of desirable flavour substances. Lipase, on the other hand, has an important effect on cheese flavour. It has recently been found that if small amounts of lipase are added to milk, a strong and slightly rancid flavour is produced in the cheese. This flavour, called by graders a "kexey" flavour, has been known for a long time, but its origin was not previously understood. Dr. Davis stated that cheese flavour is for the most part bound up with the lipolytic enzymes, which may be inherent in the original milk or of bacterial origin. The mild flavour of cheese made from pasteurized milk, or from very clean milk, can be correlated with the absence of bacterial lipase.

Quality in cheese was also dealt with, but from an entirely different angle, by Dr. G. W. Scott Blair. He pointed out the desirability of establishing objective criteria, both for controlling the various stages in the making of cheese and in the assessment of its final quality, rather than relying entirely on subjective personal judgment, though the latter could never be entirely dispensed with. He described new methods and apparatus, devised by himself and his colleagues at Shinfield, by which certain of the rheological properties of cheese and other products can now be measured in C.G.S.

units. One of these is a simple practical apparatus for deciding when curd shall be pitched (allowed to settle), the correct timing of which is highly important from the point of view of cheese quality. This apparatus, already in use in a few cheese-manufacturing centres, gives a numerical measure of the quality of the cut curd just before pitching time, which enables this time to be decided with some precision. Dr. Scott Blair showed also another simple apparatus, recently made for measuring the 'body' of ripening (or ripe) cheese, previously assessed literally by rule of thumb (pressure) or by the use of a special skewer. He described a rather more complicated apparatus now in use by which it is possible to maintain constant pressure per unit area on a sample of material the cross-section of which is increasing, and mentioned some of the unexpected results which cheese and a variety of materials have recently given when tested by it.

APPLICATION OF X-RAYS TO THE STUDY OF ALLOYS*

BY DR. H. LIPSON,
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THE use of X-rays has proved to be of fundamental importance in the investigation of alloy phase diagrams. The classical methods—cooling curves and the microscopic examination of etched surfaces—are, of course, of immense value where the problem is simply that of the precise determination of phase boundaries, and it is probable that the use of X-rays for this purpose is not of great importance. Where, however, more complex problems of equilibrium arise, the knowledge of crystal structures involved is essential.

As an example of this may be quoted the system aluminium-copper. Several investigators[1] had recorded their views on that part of the system which lies between 15 and 30 per cent aluminium ; but it was first found by X-rays[2] that the problem was not one of ordinary phase equilibrium. The phases have all essentially the same crystal structure, and vary only in the way in which the two sorts of atoms are arranged on the positions available. This results in changes of symmetry[3] which are not ordinary phase changes and which do not produce regions of two-phase equilibrium. Thus the problem is not one of which the microscope could be expected to produce a solution.

For the investigation of this type of structural change it is necessary to use apparatus of high resolving power. As in certain types of optical interferometer, this is achieved by using the high orders of interference, particularly those which are scattered back almost into the incident X-ray beam. Since, however, the deviation of a particular order is fixed by the dimensions of the unit cell and the wave-length of the radiation, the only control one has over the resolution lies in the dimensions of the apparatus. Increasing distances decrease the intensity of the diffracted beams, and so the advantage of increased resolution has to be balanced against the disadvantage of increased exposure time. Progress has therefore been dependent on the improvement of X-ray tubes and X-ray film, and at the present day cameras can be used which would have been considered of fantastic size only ten years ago. At Prof. W. L. Bragg's laboratory in Manchester in 1924 a camera of diameter 2·5 cm. was used, followed by one of 5 cm. In 1926 a 'large' camera of 9 cm. diameter was introduced and was used to find the structure of γ-brass[4]. This camera was a standard instrument for many years, and in 1934 a still larger one of 19 cm. diameter was made and was used for special problems[5]. At Cambridge this has now become the standard instrument, and a camera of 35 cm. has also been used with some success[6]. With this camera it is probable that the limits of resolution for the high orders have been reached, but still larger ones may be necessary for separating the multitude of lines at low angles given by complex structures.

PHASE DIAGRAMS

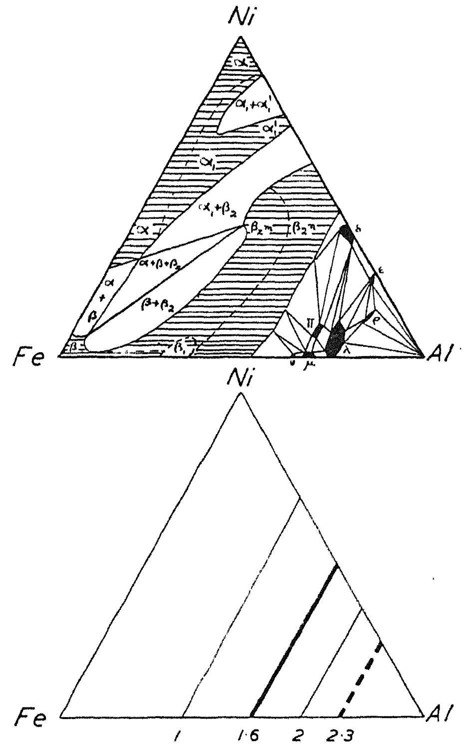
Although the most important function of X-rays must always be the determination of crystal structures, a great deal of valuable information has been obtained about the equilibrium, and approach to equilibrium, of many alloy systems. This information merely adds to the vast amount already obtained by the standard methods of metallurgy ; but it is data which would be obtainable in no other way. The reason for this is two-fold. First, each phase gives its own characteristic X-ray

* Many references are made to the paper by Bradley, Bragg and Sykes (*J. Iron and Steel Inst.*, **141**, 63 ; 1940) as well as to original papers. This is referred to in the footnote references as '*B.B.S.*' followed by the page number of the particular item. The diagrams are also from this paper.

pattern, and secondly, incomplete approach to equilibrium is usually indicated by broadening of the X-ray lines. In most binary systems the first point is not of great importance, since any method which will distinguish between an alloy which is duplex and one which is not—the only two possible equilibrium states—will give all the information needed. This, however, is not true for ternary systems; for these a technique is needed which will distinguish the various phases. This is a difficult matter for the microscope, but falls naturally within the scope of X-rays. This explains the comparative ease with which ternary equilibrium can be studied by X-rays. The discovery of new intermetallic compounds has arisen as easily and as naturally as the discovery of new stars followed the invention of the astronomical telescope.

Of more practical importance, however, is the study of the equilibrium of the simpler structures. The number of reflections is small, and any variations in their sharpness are easily noticed. An interesting example of this occurs in the iron-nickel system. It had been known for some time that it was difficult to produce equilibrium in certain iron-rich alloys, many of the physical properties showing hysteresis in their variation with temperature. With normal heat treatments X-ray photographs showed lines that were very blurred, but it was found that by heat treatment at low temperatures for lengthy periods much sharper lines were obtained. This gave a valuable indication of the direction of the approach to equilibrium, and two diagrams[7,8] based solely on X-ray data have recently been published. The second has perhaps departed too far from probability, but the first, although it has received some support from magnetic measurements[9], is still too simple to explain all the experimental results.

Another most interesting phenomenon occurs within this same system. Although in their equilibrium state certain alloys contain both body-centred and face-centred cubic phases, they can be maintained as single-phase alloys with a face-centred structure by quenching from high temperatures. If such a single-phase alloy be now put into liquid air, its structure changes over completely to body-centred cubic. This does not happen if the alloy is in the duplex state. At first sight it seems rather paradoxical that alloys which are so reluctant to change their structures at temperatures as high as 400° C. should be able to change so completely at $-200°$ C. The explanation lies in the difference between transformations which require migration of atoms and those which do not. The change from a single-phase state to a duplex one requires that atoms of one sort shall move from a uniform distribution in the alloy to one of greater concentration in certain crystal grains. This may involve the atoms in total movements of many atomic diameters, and this process of diffusion is helped by thermal agitation. Below a certain temperature, diffusion may be so slow that it is negligible, and a structure which is not that of lowest free energy may be 'frozen in'. The change from one single-phase structure to another, provided it does not involve complicated motions of the atoms, can take place without the help of thermal agitation, since it does not demand migration of the atoms. In this case the change can take place as soon as the temperature is such that the free energy of the second structure is lower than



A COMPARISON OF THE TERNARY DIAGRAM FOR FeNiAl WITH THE CORRESPONDING ELECTRONIC RATIOS.

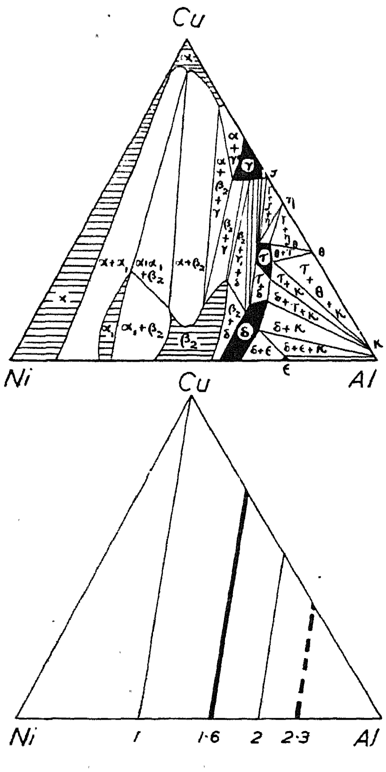
that of the first, although neither of these states may be that of lowest free energy for the particular ratio of atoms concerned.

Approach to Equilibrium

Many alloys of modern discovery have their best properties when they are not in their equilibrium states, and thus the study of equilibrium can give only an incomplete answer to the problems of metallurgy. The steels, for example, though handled with such consummate skill by the technician, still remain a closed book to the theoretician. A valuable start has, however, been made on the explanation of the properties of certain other alloys.

Perhaps the most fascinating of these studies is that of the age-hardening of aluminium alloys. The work of Guinier[10] and of Preston[11], who have used the oscillating crystal method, has shown that the atoms of the alloying element, copper, tend to precipitate out along planes in the original aluminium lattice. This effect was manifested on the photographs only by certain faint streaks which may have remained unnoticed by less meticulous workers.

Another subject which has been tackled with some success by X-rays is the Mishima permanent magnet alloy, which is essentially Fe_2NiAl. Bradley[12] has produced a very plausible theory of the origin of the strains which are the cause of the high coercivity. Some alloys in the system Fe-Cu-Ni seem to go through a similar process in the dissociation into two phases, and here it has been found possible to arrest the process at different stages, which can then be closely examined by X-rays[13]. Here again it appears that the precipitation takes place along planes, although it is on a much larger scale than in the age-hardening alloys. The work of Mott and his school[14] is contributing greatly towards the explanation of this phenomenon; but no theoretical method has yet been found for correlating these structures with the tensile strength and hardness of the alloys.



A COMPARISON OF THE TERNARY DIAGRAM FOR CuNiAl WITH THE CORRESPONDING ELECTRONIC RATIOS.

FACTORS AFFECTING THE OCCURRENCE OF STRUCTURES

Of parallel importance to the deduction of the physical properties of alloys from their crystal structures is the deduction of the crystal structure from the composition. In this, more positive results have been obtained, based on the now famous Hume-Rothery rule[15]. This points out that there is a general connexion between crystal structure and concentration of valency electrons. By valency electrons is meant those electrons in the outer shell of an atom which are not firmly bound to the nucleus; it is these electrons which give to the atom its peculiar metallic properties. Copper atoms, for example, have one such electron, zinc atoms have two, and aluminium atoms have three. The transition elements, such as iron, which have incomplete inner shells, may take extra electrons into those shells and thus cancel out the effect of their own valency electrons. Thus over large ranges of composition these elements behave as though they were nulvalent.

The valency electrons may be considered as trains of waves moving in the three-dimensional field of the nuclei. The interactions of the two may be summed up in a very neat geometrical way, using the concept of 'reciprocal space'[16]. Planes are drawn which bisect at right angles the lines joining the origin to each point of the reciprocal lattice. Those planes which are connected with strong X-ray reflections should also be connected with strong reflection of those electron beams which make the right angle with them and have the right energy. It has been shown, however, that waves of these energies are forbidden[17]. With these forbidden energies is associated a band of energies which is large when the X-ray reflection is large, and tends to zero as the reflection tends to zero. Electron states may also be plotted in reciprocal space (it is in this case usually called k-space), and the effect may be interpreted as a reduction of energy for those states which lie just within the planes, and an increase for those which lie just outside.

The planes outline zones called 'Brillouin zones', and the volumes of these give the numbers of electrons per atom which they can contain. These numbers are of importance only when the highest occupied electronic states are in the neighbourhood of the surface of a Brillouin zone. This is not the case for a monovalent metal such as copper, and the structure is fixed by other considerations. The first Brillouin zone for the face-centred cubic structure of copper is very uneconomic for holding more electrons, however, as some of its faces are much closer to the origin than are others. Thus, if electrons are added, for example, by adding zinc,

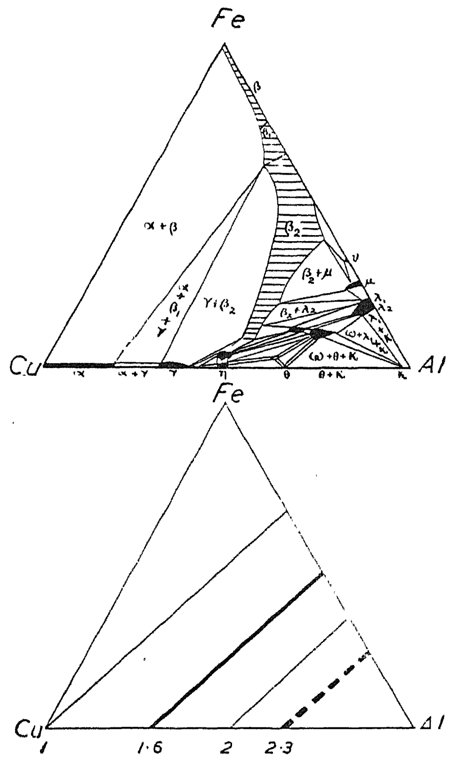
the electronic states must either overlap into the second zone or spread out along the surface of the first zone. Both these processes involve rapid increases of energy, in the first case, because of the energy discontinuity, and in the second, because the states occupied quickly become farther from the origin. Thus, another structure may be favoured. The body-centred cubic structure has a Brillouin zone of which the faces are farther from the origin than are those of the face-centred cubic structure. More electrons can therefore be added before the rapid increase of energy occurs, and so the occurrence of this structure in the copper-zinc system is accounted for. When the electronic states reach the boundary of this zone another adjustment may be made. The atoms are rearranged in such a way[4] that they give a Brillouin zone which is almost spherical. Thus the last electrons added are in states of depressed energy, since they must all be near the boundary.

After this stage has been reached in the copper-zinc system, the electrons give up the attempt to confine themselves in the first Brillouin zone, and quite different structures follow. In the copper-aluminium system, however, the electrons make a last desperate attempt to confine themselves within the zone. The number of atoms per unit cell is reduced as electrons are added, and the number of electron states occupied in each Brillouin zone remains practically constant[18]. The same device is resorted to in the body-centred phase field of the aluminium-nickel system, and this results finally in a rhombohedral deformation of the structure[19]. Direct experimental support for these ideas is given by the fact that in the aluminium-copper-nickel system the effects are extended along lines of constant electron concentration[20].

The theory can give a rough estimation of the phase boundaries in systems which contain the structures mentioned above, and quite good agreement with experimental results is found. Moreover, the frequent occurrence is accounted for of complicated structures based on the body-centred cubic structure, whereas those based on the face-centred structure are very rare.

The importance of electron concentrations in ternary alloys is illustrated in the accompanying illustrations, which show a comparison of the important features of three ternary systems with their lines of constant electron concentration[21]. The lines of 1·6 and 2·3 electrons per atom are shown, and it will be seen that these lines coincide roughly with the limits of the body-centred cubic phase fields, and of the complicated structures, respectively.

From all these facts it seems fairly certain that the Brillouin zone theory must form the main



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basis of the study of equilibrium in alloy systems, and further attention must be directed to those factors which govern the finer detail of the diagrams. This, unfortunately, is not likely to yield any immediate results, as it requires a method of calculating the free energies of different structures, but in any event, one can say that there is no lack of raw material for the theoretical physicist.

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AIR RAID DAMAGE

University of London

UNIVERSITY COLLEGE. Some details have already been published in the Press regarding the very serious damage done to the College buildings. The main damage is to the original building and, in particular, to the Library, in which about a 100,000 books have been destroyed. All Faculties of the College remain evacuated.

KING'S COLLEGE. A high explosive bomb fell in the quadrangle, but the damage was less severe than might have been expected. The College had already been evacuated.

WESTFIELD COLLEGE. Incendiary bombs have done damage which is, however, not serious ; the College remains evacuated.

BIRKBECK COLLEGE. Very serious damage has been done by fire resulting from incendiary bombs. Three laboratories were completely gutted and a fourth severely damaged and a considerable portion of the roof of the theatre destroyed. The main building suffered also from water. The College, however, continues to function.

SCHOOL OF ORIENTAL STUDIES. Some damage, not considerable, was done to the new building from a high explosive bomb.

GOLDSMITHS' COLLEGE. The buildings have been damaged twice and partly wrecked.

MEDICAL SCHOOLS : *St. Bartholomew's :* severe damage has been done to that part of the College which adjoins the hospital. Later, the roof of the College Hall in Charterhouse Square was destroyed by incendiary bombs, and considerable damage was caused by water. *St. Thomas's :* very severe damage has been done, but work is continuing. *Guy's :* headquarters and also school properties at Tunbridge Wells have been damaged. *London :* damage has been done to the Dissecting Room, the Bacteriological Department and Students' Hostel. *London School of Medicine for Women :* damage has been done by incendiary bombs, particularly to the Anatomy Department ; other departments damaged by water. Students' Hostel severely damaged by blast.

Royal College of Surgeons

BLAST has broken all the windows and window frames on the north front of the Royal College of Surgeons, torn off doors inside the building and shattered many of the roof lights in the Museums. No structural damage was done except to two partition walls on the fourth floor, which houses the work rooms for the Museum. In the Library Reading Room, little damage was caused. Books and periodicals were found in the College forecourt and on the roadway outside. Broken glass and soot covered the periodical tables and lay thickly all over the floor. Careful cleaning of the books and periodicals was started by the staff and, within a day, the reading room, although windowless, was in use again. Ceiling and shelves damaged by the blast were repaired rapidly and the window openings boarded up. The Museum damage was relatively slight. In Room I, some of the shelving on which is housed the craniological collection collapsed and about twenty skulls were damaged, but most of them not irreparably. Anatomical specimens, also in the wall cases, escaped major damage. Specimen jars were cracked or broken, but no specimens were lost. Room V and the War Museum have also been damaged. Roof lights in Room V were broken and most of the windows of the War Museum were smashed. About one hundred specimen jars were either broken or cracked, but all the specimens were retrieved and identified.

Precautions which had been taken to protect the Museum specimens worked admirably. Historic specimens and a complete series of pathological material suitable for medical students were stowed in a safe place almost two years ago, the idea being, that if the remainder of the Museum were destroyed, its connexion with John Hunter and his work would be preserved, and its usefulness to coming generations of students would remain unimpaired. Arrangements are now being made to remove at least the whole of the Periodical Collection in the Library to a safe place, so that, in the event of further air activity, at least one large series of medical periodicals would remain intact. The laboratories of the College suffered little damage beyond broken windows and wood frames, but as a precautionary measure the laboratories are being moved out of London.

Museum of Practical Geology

THE office block has been hit by a high explosive bomb. Two office rooms were damaged and about a quarter of the windows of the building were broken, together with others in surrounding buildings. Little damage was done to material in the Museum.

Royal Observatory, Greenwich

THE Observatory has been damaged by high explosive and incendiary bombs. The revolving globe and observatory clock and parts of the telescope room were damaged, but the time ball continues to function.

University of St. Andrews

MOST of the windows of one side of the University Library have been broken and damage has been done to books, especially those in the Science Reading Room. One wall of the new building housing the Departments of Botany and Geology has been seriously damaged, and the Bute Medical Buildings were also affected, much damage being done by the breakage of skylights and windows.

University of Manchester

THE University and the College of Technology have suffered certain damage.

NEWS AND VIEWS

Pitfalls of the Tannic Acid Treatment of Burns

IN the past several months opportunities for testing the tannic acid treatment of burns have been only too abundant, and the method, which was highly commended at the start of the War, has not emerged from the tests so successfully as had been expected. The Minister of Health recently stated in the House of Commons that tannic acid is not satisfactory for certain types of burns and more definite statements had previously been made by authoritative speakers in the course of a discussion at a meeting of the Royal Society of Medicine. Thus, Rear-Admiral C. P. G. Wakeley said that no tannic acid preparation must be used on burns of the hands or face, and he gave ample reasons for this opinion. Mr. A. H. McIndoe said the local treatment of war cases has shown that coagulation treatment, especially by tannic acid, has been carried too far. So overwhelming is the evidence that this method is fraught with great danger when applied to burns of the hands and face, that first-aid posts have been officially instructed not to use tannic acid in the treatment of them.

It might be a wise course to advise the public generally of these dangers since hundreds of thousands of tannic acid preparations were bought by them in the early stages of the War, before experience had shown the defects of the treatment. The use of tannic acid in the treatment of burns is a comparatively recent innovation; it was first described in 1925. The rationale of the treatment is based on two factors as explained by Dr. Ethel Browning in "Modern Drugs in General Practice" as follows: (*a*) its precipitation of tissue proteins, with formation of a coagulum which prevents absorption of toxins, and (*b*) the analgesic and protective covering afforded by this coagulum.

Galapagos: a Zoological Landmark

IN September 1835 Charles Darwin landed on the Galapagos Islands, and twenty-four years later the "Origin of Species" was published. The two events are linked together, almost as cause and effect, in the history of the theory of evolution, for, according to Darwin himself, the conception of the "Origin of Species", and all that it meant in revolutionizing the outlook of men, lay away back in that month's visit to the Archipelago. It was a touch of inspiration that suggested to William Hunter and David Lack that the sort of evidence which appealed to Darwin might be embodied in a cinematograph film of the Islands and their characteristic vegetation and animals. Their film, "Galapagos", produced by the Dartington Hall School Film Unit, is a novel and notable instrument for bringing realism to many biological truths the evidence of which students often find it difficult to appreciate. The zoning of plants and animals is illustrated by the waterless and porous lava formations of the low grounds with xeprohytic vegetation and scanty fauna, and by the rain-forest of the misty uplands; the effect of isolation, by endemic animals showing various degrees of distinctiveness from their mainland ancestors. An outstanding example of adaptive radiation is illustrated by the ground-finches, six different types of which range from the normal seed-eater to the remarkable Cactospiza, which is seen digging insect larvæ from their lairs by means of a twig—a tool-using bird.

Darwin paid much attention to the unique reptiles of the islands and they are here well shown, the land and sea-lizards and the giant tortoises, although we should have appreciated a comparative picture of some of the different island forms of the tortoises which so much impressed the naturalist of the *Beagle* and Mr. Lawson, who first pointed them out to him. The zoologist will see many other good teaching points in this valuable film, the photography of which, made during the Lack-Venables Galapagos Expedition of 1938–39, is of the highest standard. Indeed "Galapagos" should be part of the teaching outfit of every department in university and secondary school which is endeavouring to impart the essential truths of zoology. It is a two-reel, 16-mm. film, occupies half an hour, is accompanied, although it is fully captioned, by teaching notes, and may be hired at a moderate rate from the Dartington Hall Film Unit, Totnes, South Devon.

Recent Earthquakes

A STRONG earth tremor with epicentre probably near Pwllheli in North Wales was felt at about 10.20 p.m., B.S.T. on December 12. The shock caused some apprehension in the town, where it rattled windows and shook floors, though no damage or casualties have been reported. The tremor was felt in Pwllheli, Conway, Carnarvon, Bangor, and also in Anglesey, and is said to have lasted about forty-three seconds. Two slight aftershocks have been reported, the first about three minutes after midnight on December 13, and the second about forty minutes later. The strong earthquake in the same area on June 19, 1903, which was preceded by a slight foreshock, was stated by the late Dr. C. Davison to have been a simple shock with the innermost isoseismal area about 33·5 miles by 15 miles, and connected with movement along the Aber-Dinlle fault. It was followed by thirty-three aftershocks, and another tremor associated with this fault occurred in 1906. Other minor disturbances have occurred in Carnarvonshire since, of which two may be mentioned. The disturbance of April 14, 1931, in south Carnarvonshire, which was attributed at the time to earth tremors, was afterwards shown to be due to a meteor which fell in the district. On January 13, 1932, there was a small tremor in south Carnarvonshire, but it was not recorded by seismographs.

Two earthquake shocks occurred at Glaruo in Switzerland at 9 a.m. and 2.30 p.m. local time on December 12. The only information available at present is that the latter shattered some houses.

Catalogue of Meteorites of the U.S.S.R.

THE scientific secretary of the Meteorite Committee of the Academy of Sciences of the U.S.S.R., Mr. L. A. Kulik, has prepared for publication a catalogue of meteorites of the U.S.S.R., which is to appear in an early issue of the Soviet publication *Meteoritika*. Up to November 1, 1939, ninety-five meteorites were counted as having been found on territory of the U.S.S.R. With the inclusion of the newly acquired territory of Western Ukraine and Western Belorussia and the Baltic republics, this number has now been increased to 112.

The Academy of Sciences of the U.S.S.R. has one of the largest collections of meteorites in the world, numbering ninety-three specimens found in the Soviet Union and fifty-five specimens which have fallen in other countries. The aggregrate weight of the Academy's collection is 4,189 lb. The collection includes some unique specimens, of which the most valuable is the 'Pallas Iron'. This is the largest meteorite in the U.S.S.R., weighing more than half a ton. It was found on the banks of the River Yenisei in 1749, and in 1771 was brought to St. Petersburg by Pallas.

Although at that time science denied the possibility of stones falling to earth from cosmic space, Pallas was convinced that the iron mass he had brought to St. Petersburg was a meteorite. The 'Pallas Iron' laid the foundation for the meteorite collection of the Russian Academy of Sciences. The second remarkable meteorite in the Academy's collection is the 'Boguslavka'. This is the largest iron meteorite in the world observed falling by eye-witnesses. The 'Boguslavka' meteorite fell on October 18, 1916, in the Far Eastern districts of Russia. It is in two parts, weighing 439 lb. and 121 lb. respectively. Another remarkable iron meteorite in the collection is one which is streamlined and shaped like the nose of a shell. The 'Pallas Iron' and 'Boguslavka' meteorites with a number of others are on view at the Karpinsky Geological Museum of the Academy of Sciences of the U.S.S.R.

Mortality in 1940

THE July issue of the *Statistical Bulletin* contains a study of the mortality of the first six months of 1940 of the many millions of men, women and children insured in the Industrial Department of the Metropolitan Life Insurance Company, New York. It shows that the record of the individual causes of death contains both favourable and unfavourable items. For each of the diseases typhoid fever, measles, scarlet fever, whooping cough, diphtheria, pneumonia, tuberculosis, diarrhœal diseases, appendicitis and puerperal conditions, the indications are that mortalities for 1940 will be lower than ever before. The same is true of homicides and all kinds of accidents combined. The greatest single achievement is reduction in a single year of 22 per cent in the mortality from pneumonia. Unfavourable aspects, on the other hand, are the continued rise in the mortality-rates from cancer, diabetes and diseases of the coronary arteries.

Origin of Cosmic Rays

AN interesting note appears in *Electrotechnics* of September, telling of the visit of Prof. R. A. Millikan and his colleagues Dr. H. V. Neher and Dr. Pickering, of the California Institute of Technology, to the Indian Institute of Science at Bangalore last January. Bangalore was one of three places in India chosen by Prof. Millikan for carrying out measurements on cosmic rays. These experiments form a part of a series conducted by him which it is hoped will yield valuable data regarding the source of cosmic rays and their precise function in the working of the universe. Results so far obtained seem to confirm his hypothesis about the behaviour of the rays and his suggestion that they create atoms of helium, oxygen, silicon and iron, and are in fact replenishing the earth's diminishing supplies of these elements almost as fast as they are used up. At the invitation of the council of the Indian Institute of Science, Prof. Millikan arranged a series of four lectures for the benefit of workers in the Institute. Of these four lectures, the first and the last were delivered by Prof. Millikan himself. In the first one he traced the history of our knowledge of cosmic rays up to the present day. The second and third lectures were given by Drs. Neher and Pickering respectively, and they dealt with the technique of measurement of cosmic rays. In the concluding lecture, Prof. Millikan gave a critical survey of the various existing theories regarding the origin and nature of cosmic rays.

Canadian Seismological Stations

ALL seismological stations in Canada now come within the jurisdiction of one department, with the Dominion Observatory at Ottawa as the Central Station (*Earthquake Notes*, 12, Nos. 1 and 2, Sept. 1940). There are seven stations besides Ottawa, and several improvements have recently been made. The Victoria station is now in the Dominion Astrophysical Observatory, where a vertical Wiechert seismograph and improved Milne-Shaw instruments are in operation. At Saskatoon two horizontal Mainka seismographs are in operation, whilst at Toronto the two Milne-Shaw seismographs have been improved by mirror replacements. The Kirkland Lake station commenced operation in December 1939 with a standard geophone and special recorder made by the Heiland Research Corporation. The Shawinigan Falls station employs a Wood-Anderson seismograph, whilst the Seven Falls station has Wood-Anderson and Milne-Shaw seismographs. The Halifax station has been entirely re-equipped. The Mainka instruments have been discarded and the station has now photographic recording Bosch seismographs formerly at Ottawa. Ottawa discarded the Wiechert vertical seismograph and installed

Benioff short- and long-period vertical seismometers in addition to the two Milne-Shaw instruments. The Canadian Broadcasting Corporation now transmits the Dominion Observatory noon time signals over the entire Canadian network, so that accurate timing is possible at all the seismograph stations. Seismograms from all the Canadian stations are now sent to Ottawa for analysis and interpretation, and the results published in the *Monthly Bulletin* issued by the Dominion Observatory.

Scientific Equipment and the Laboratory

IN the *Nivoc Supplement* (edited and published by Messrs. W. and J. George, Ltd.—F. E. Becker and Co., London and Birmingham, No. 17, July 1940) the importance of up-to-date scientific equipment in, and correct planning of, a laboratory is stressed. Facilities for research and scientific control and testing have become an essential part of manufacturing organizations. Particularly is this so in the case of companies supplying materials to the aircraft industry, since the progress of aeronautical development is largely dependent upon the development of improved materials, both for air-frames and engines, and a very high standard of material testing and inspection has been set up. It is therefore necessary for the supplier of materials to maintain adequate research and testing establishments staffed with competent personnel. Messrs. George have recently equipped new laboratories for High Duty Alloys, Ltd. New buildings, designed by Colonel A. L. Abbott, house eleven different laboratories and departments in addition to a library and lecture theatre, and are considered to be an outstanding example of modern laboratory planning and furnishing. Teak bench tops are strongly advocated for general use. A brief note is given on the Burma teak forest and methods of exploitation, the information having been made accessible by the High Commissioner for India.

Cancer Research

IN order to ensure opportunities for the publication of the scientific results of cancer research, a group of representatives of interested organizations are to co-operate in making possible a new journal *Cancer Research*, to be devoted to articles and abstracts of articles having to do with cancer research. This journal is sponsored by the American Association for Cancer Research, the Anna Fuller Fund, the International Cancer Research Foundation, and the Jane Coffin Childs Memorial Fund for Medical Research. It is hoped to start publication with the issue of January, 1941. Manuscripts should be addressed to the Secretary of the Editorial Committee, 333 Cedar Street, New Haven, Connecticut. Subscriptions are now being received at the office of the Business Manager, American Oncologic Hospital, 33rd Street and Powelton Avenue, Philadelphia. Annual subscription, one volume of twelve issues per year, will be: to members of the American Association for Cancer Research, five dollars; to non-members, seven dollars.

Announcements

As president of the Royal Society, Sir Henry Dale becomes *ex officio* a member of the War Cabinet Scientific Advisory Committee under the chairmanship of Lord Hankey. Sir William Bragg, at the special request of Lord Hankey, will remain a member of the Committee until next October, when he will have completed a year of service with it.

DR. J. HUTCHINSON, keeper of museums of botany, Royal Botanic Gardens, Kew, has been awarded the Loder Rhododendron Cup of the Royal Horticultural Society.

PROF. W. M. SMART, regius professor of astronomy in the University of Glasgow, has been appointed Halley Lecturer at Oxford for 1941.

PROF. G. PÓLYA, formerly professor of higher mathematics in the Technical High School, Zurich, has joined the Department of Mathematics in Brown University.

IN moving the second reading in the House of Commons of the War Damage Bill, Sir Kingsley Wood, Chancellor of the Exchequer, announced that whereas the general charge on buildings, etc., would be at the rate of 2*s*. in the pound on the annual value, that on institutions for the advancement of education, science or research would be at the rate of 8*d*. in the pound. Agricultural properties are to pay 6*d*. in the pound, and hospitals and churches are exempted from payment.

THE title of professor of physics as applied to medicine in the University of London has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital (Free). The following have been awarded the degree of D.Sc.: Mr. J. H. Burgoyne (Imperial College of Science and Technology); Mr. S. L. Cowan (University College); Mr. C. H. Johnson (University College); Mr. R. W. B. Pearse (Imperial College of Science and Technology); Mr. M. J. D. White (University College); Mr. J. G. King, an external student. The Sir John William Lubbock Memorial Prize in mathematics for 1940 has been awarded to Mr. M. G. Pimputkar, of University College.

APPLICATIONS for fellowships under the Finney-Howell Research Foundation, Inc., for 1941 must be made by January 1. This Foundation was provided for in the will of the late Dr. George Walker of Baltimore for the support of "research work into the cause or causes and the treatment of cancer". Fellowships carrying an annual stipend of 2,000 dollars are awarded for a period of one year, with the possibility of renewal up to three years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship. The address of the Foundation is 1211 Cathedral Street, Baltimore, Maryland.

IN NATURE of December 7, p. 743, reference was made to the jubilee of the City and South London Railway. We regret to learn, however, that the details of reconstruction work given in the second paragraph refer to the Waterloo and City Railway.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Diffuse Reflections on Laue Photographs

Sir C. V. Raman and P. Nilakantan, having first of all in NATURE[1] described the appearance of diffuse spots and streaks on Laue photographs as "a new type of X-ray reflection", now claim[2] that they were justified in ignoring all previous experimental and theoretical work on the subject. Their claim, however, cannot be admitted. Preston's photographs[3] of aluminium, sodium chloride and magnesium oxide, at room temperatures and at 500° C., were beautifully clear and typical of the phenomenon, whether his theory be accepted or not, while his photographs taken with monochromatized radiation proved beyond a doubt that the diffuse spots were due to the characteristic part of the beam. A further purely experimental paper, which pre-dates the work of Raman and Nilakantan, is that of Jean Laval[4], "Étude Experimentale de la Diffusion des Rayons X par les Cristaux", which is a most comprehensive study of the phenomenon using ionization spectrometer methods.

Nor can the previous theoretical work, whether of Brillouin[5], Faxén[6], Waller[7], Preston[3] or Zachariasen[8], be so lightly dismissed. Raman and Nilakantan state that certain limited observations on diamond "wholly exclude any explanation of these reflections in terms of the diffuse thermal scattering of X-rays". Yet Preston showed that at elevated temperatures the intensity and size of the diffuse spots given by aluminium, sodium chloride and magnesium oxide are remarkably increased, and that some new spots appear that were not previously visible, while the Laue spots suffer a corresponding diminution in importance; he also found a slight increase in the effect for diamond. Laval observed and measured a marked temperature enhancement of the effect in the case of potassium chloride, while Raman and Nilakantan[9] observed the same for sodium nitrate.

In this laboratory we have taken many photographs at liquid air temperatures, and have found that for potassium chloride, sodium nitrate, calcium carbonate and every organic compound so far examined the diffuse reflections have either almost or completely disappeared at −180° C., while the Laue spots have increased in definition and number. It is true that for diamond alone the diminution of intensity at liquid air temperatures is slight, but on the other hand the characteristic temperature of diamond is exceptionally high (2340° A.), and a change of temperature of 200° is relatively unimportant. These temperature changes are completely reversible in every case, and are so striking that it seems unnecessary to suppose the phenomenon to be anything but a temperature effect, although the exact manner in which the thermal movements of the particles are related to the structure and to the elastic constants of the crystal is still a matter for further theoretical investigation.

The empirical formula which Raman and Nilakantan[10] have given for diamond, $\lambda^* \sin(\theta + \varphi) = \lambda \cos \varphi$, where θ, φ are the glancing angles of incidence and reflection with respect to the crystal planes of which λ^* is the spacing, is identical with the simple formula given by Faxén in 1923[6], a ($\sin \theta + \cos \theta \tan \theta_1) = \lambda$, where a and θ_1 have the same significance as λ^* and φ. This simple formula, however, though it may apply approximately in certain cases, was never intended to be generally applicable. It occurs, but again only as an approximation, in Waller's more complete exposition of the effect of thermal vibration of atoms in a crystal on X-ray scattering[7]. This effect is dependent upon the elastic constants of the crystal, and the theory cannot be fully tested unless these are known; but in principle the effect of thermal vibration in reducing the atom-factors, of which the theory of diffuse thermal scattering is a necessary corollary, is universally accepted[11].

KATHLEEN LONSDALE.
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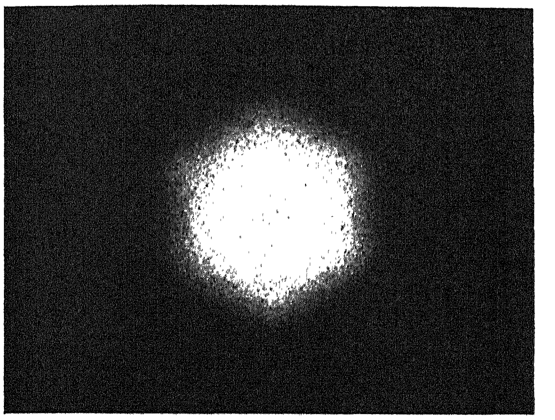
[1] Raman and Nilakantan, NATURE, **145**, 667 (1940).
[2] Raman and Nilakantan, NATURE, **146**, 686 (1940).
[3] Preston, *Proc. Roy. Soc.*, A, **172**, 116 (1939).
[4] Laval, *Bull. Soc. Française Min.*, **62**, 137 (1939).
[5] Brillouin, *Ann. Phys.*, **17**, 88 (1922).
[6] Faxén, *Z. Phys.*, **17**, 266 (1923).
[7] Waller, *Z. Phys.*, **17**, 398 (1925); dissertation, "Theoretische Studien zur Interferung- und Dispersionstheorie der Röntgenstrahlen". *Uppsala Univ. Arsskrift.*
[8] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).
[9] Raman and Nilakantan, *Proc. Ind. Acad. Sci.*, **11**, 405 (1940).
[10] *ibid.*, p. 393.
[11] Waller and James, *Proc. Roy. Soc.*, A, **117**, 214 (1927); "Int. Tabellen zur Bestimmung v. Kristallstrukturen", **2**, 559 (1935).

Grinding and Scratching Crystalline Surfaces

IT is well known that the orientations with respect to the crystalline axes of the facets of the etch figures on a basal plane of quartz can be used to locate the a axis of the quartz. De Gramont[1] has described a convenient method by which this may be done. A face of the specimen parallel to the etched surface is polished and a point source of light is viewed through the specimen normally to the etched surface. A pattern, consisting of spots of light, is formed, due to refraction at the facets of the etch figures, and the orientation of these facets, relative to the crystal lattice, may be found from the positions of the spots of light.

This method of studying a surface broken up into a large number of small facets of various orientations can be applied to the study of the ground surfaces of transparent materials, and yields interesting results with crystals. Thus, if a (0001) plane of quartz is ground, instead of etched, and viewed in a manner similar to that used by de Gramont, a refraction pattern of the type shown in the accompanying reproduction is seen. The intensity distribution over the pattern can be interpreted in terms of the orientations of the facets formed on the surface in the process of grinding, and in terms of the extent to which facets of any specified orientation occur.



A density analysis of the above photograph, made by the 'sharp outline' method described by Dobson, Griffith and Harrison[2], shows that preferential fracture of the quartz takes place on planes belonging to the zones $(1\ 0\ \bar{1}\ l)$. The diameters of the hexagon bisect the angles between the a axes, and hence the pattern can be used to determine these axes even when the quartz crystal does not possess natural faces.

Refraction patterns have also been obtained for ground surfaces parallel to other planes of quartz than the (0001) plane, and for ground surfaces of calcite, selenite, rock salt, etc., and for surfaces of these crystals on which a large number of parallel scratches is made.

Generally, any marked cleavages possessed by a crystal are apparent in the refraction patterns of ground or scratched surfaces of the crystal. The refraction patterns are not, however, entirely explicable in terms of the usually observed cleavage planes, but lead to the assumption of a number of zones of easy fracture. The patterns formed on scratched surfaces depend to some extent on the direction of scratching, as well as on the surface of the crystal which is used.

The results obtained can in some cases be partially confirmed by microscopic examination of the ground or scratched surfaces.

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Nov. 18.

[1] de Gramont, A., "Recherches sur le Quartz Piezoelectrique". (Editions de la *Revue d'Optique Theorique et Experimentale*, 1935.)

[2] Dobson, G. M. B., Griffith, J. O., and Harrison, D. N., "Photographic Photometry" (Oxford, 1926), p. 42.

Electron Diffraction Intensities

Yearian[1] and Lark-Horovitz[2] have explained certain anomalies in the intensities of the rings in electron diffraction patterns of zinc oxide on the assumption of atomic distortion. It is, however, implicit in their calculations that extinction of the electron beams owing to inelastic scattering has an equal effect on all diffractions; this would not seem to be the case.

It has been shown both with the microscope[3] and by electron diffraction[4] that the structure of zinc oxide coagulated from an ærosol consists partly of very thin filaments, and that it is these that are mainly responsible for the diffraction of electrons. The sharpness of the $(00.l)$ as compared with the $(hk.0)$ diffractions shows that the crystals are longest along their c axes, which presumably coincide with the axes of the filaments. Thus the depth of crystals to be penetrated by an electron beam is greater along the c axis than along the a or b axis, and consequently greater extinction results. Fewer crystals will be small enough to transmit electrons along the c axis than can do so along the a or b axis. In this way the intensities of the $(hk.0)$ diffractions should be reduced as compared with those of the $(00.l)$ diffractions, as is observed experimentally.

Experiments with suitably evaporated metal films[5] have shown good agreement between calculated and observed diffraction intensities, and in these cases the ring-breadths give no indication of rod- or plate-shaped crystals. It seems to me that variations in extinction due to irregular crystal shape or to anisotropy will explain at least qualitatively many of the observed differences between calculated and observed electron diffraction intensities.

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Nov. 21.

[1] Yearian, *Phys. Rev.*, **48**, 631 (1935).

[2] Cf. Thomson and Cochrane, "Theory and Practice of Electron Diffraction" (London: Macmillan, 1939).

[3] Whytelaw-Gray, Speakman and Campbell, *Proc. Roy. Soc.*, A, **102**, 604 (1923).

[4] Finch and Fordham, *Proc. Phys. Soc.*, **48**, 85 (1936); also Finch and Wilman, *J. Chem. Soc.*, 751 (1934).

[5] Thomson, G. P., *Proc. Roy. Soc.*, A, **125**, 352 (1929); also Mark and Wierl, *Z. Phys.*, **60**, 741 (1930).

Increase of Heavy Potassium in Plasma

IN a previous communication[1] we described results of investigations on the isotopic constitution of potassium in normal and tumour tissue from the rat. It was shown that the percentage of the heavy isotope, $^{41}_{19}K$, in potassium present in bone-marrow and Jensen sarcoma differed slightly from that in mineral potassium, being higher in the former case, lower in the latter.

Similar investigations have since been carried out on potassium in the blood plasma of normal rats. Five plasma samples were tested, each being a mixture obtained from an equal number of males and females; the animals numbering 2–12 had an average weight between 155 and 220 gm. The blood, taken by heart puncture, was added to a sodium citrate solution and centrifuged immediately. The ash of the citrate-plasma was used for the mass-spectrographic measurement.

The results showed that the content of $^{41}_{19}$K in plasma potassium was distinctly higher than in mineral potassium contained in ordinary potassium chloride (A.R.). The average increase was 2·5 per cent, the individual figures varying between 1·8 and 3·2 per cent. This increase was of the same order as that found in potassium from bone-marrow. Since potassium from all normal tissues other than bone-marrow has shown a $^{41}_{19}$K content close to that of mineral potassium, it appears that the assimilation of potassium by the cell is connected with an isotope effect. A kinetic mechanism, concerned with the movements of $^{39}_{19}$K and $^{41}_{19}$K atoms, can be devised to account for this effect.

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Nov. 28.

[1] Lasnitzki, A., and Brewer, A. K., NATURE, **142**, 538 (1938).

Nature of the Feulgen Reaction with Nucleic Acid

THROUGH the courtesy of Messrs. Barber and Price I have now seen particulars of the tests referred to in their criticism[1] of my note[2] on the nature of the Feulgen reaction with nucleic acid. It is obvious from their account that they have failed to see the main point of my suggestion, that is, that polymerization, via a nitrogen linkage, between leuco-base of fuchsine and the purines available in hydrolysed chromatin is just as likely to result in a coloured product as the similar polymerization between aldose and leuco-base via an oxygen linkage. Their experiments, though apparently made in good faith, were mainly concerned with certain elementary details of the Feulgen reaction which have no bearing on my suggestion.

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Department of Cytology,
King's College,
at the
University of Bristol.
Nov. 8.

[1] Barber, H. N., and Price, J. R., NATURE, **146**, 335 (1940).
[2] Semmens, C. S., NATURE, **146**, 130 (1940).

MR. SEMMENS' "suggestion" that purines available in hydrolysed chromatin might be responsible for Feulgen staining was quite clear to us, and it was to test it that we re-examined the behaviour of certain purines with the Feulgen reagent. Since these experiments were a repetition of Semmens', their bearing on the point in question should be sufficiently clear to him. We consider his suggestion untenable because our tests, contrary to his, show that purines do not give any colour with the Feulgen reagent.

The reason we repeated these experiments was that they led to a grave theoretical difficulty, namely, that yeast nucleic acid and thymonucleic acid, which have the same purine components, give a different Feulgen reaction. This difference we consider (in agreement with the general view) as due to the different carbohydrate components of the two acids.

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Nov. 8.

Mind and Matter

MAY I say how touched I am by the spirit with which your reviewer, F. S. Marvin, points the moral "that mind and not matter rules the world"[1]. I also was taught to believe that mind came first, and I should naturally prefer to retain a conviction which has been sufficient for so many generations of historians and philosophers. But admittedly, the bearing of this observation lies in the application of it, and I am compelled to ask myself how I am to apply the priority of mind to my own detailed and perhaps trivial explorations.

I am concerned with chromosomes. Some people have come to look upon these microscopic whim-whams as determining (if one may speak of determination) the properties of heredity and development. Now if the chromosomes determine the development of the whole organism, of which the mind is one (albeit the most precious) aspect, then these scarcely animate particles of matter, the mutations of which obey elementary physical laws, can determine the difference between mind and no mind at all; and particularly, if I were to follow this argument, I should be led to a most disturbing conclusion, namely, that the sperm which will give rise to a man (and his mind) differs from one which will give rise to a female of the species (and her mind) merely by the absence of a piece of one chromosome, a speck of matter. To this end are we led through blindly following the sophistries of material dialecticism, which (as Mr. Marvin laments) are so prevalent to-day. This view needs only to be stated for its contradictory nature to become evident.

On the other hand, if mind or spirit or purpose determine both sex and loss of chromosome at the same time, everything will, I suppose, be clear and straightforward. I say, 'I suppose', since Plato and Aristotle were unfamiliar with this situation, and Epicurus in any event gives me the wrong answer. I now turn to Mr. Marvin in confidence that he will be able to tell me (with or without the help of Dr. Federn) how I may come to apprehend a deeper truth from the misleading images recorded by science. Then I may perhaps myself be able to rewrite the present theory of heredity with a proper appreciation of higher things.

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Nov. 13.

[1] NATURE, **146**, 600 (1940).

RESEARCH ITEMS

Biological Control of Lantana

IN *Indian Forest Records* (Entomology) (6, No. 3; 1940) C. F. C. Beeson and N. C. Chatterjee discuss the possibilities of the biological control of *Lantana aculeata*. The problem of destroying Lantana by means of insects is one of special interest to forest officers in India. It is concluded that no indigenous species of insects feeding on this shrub is sufficiently promising for this purpose, yet altogether 400 species of insects are known to visit Lantana in India. In the Dehra Dun district the biology of 54 species has been investigated. The regular breeders on the plant are prevented from increasing abundantly by wilt-like diseases and parasites. The most promising lines for the future seem to be (*a*) the introduction of the Lantana bug, *Teleonemia scrupulosa* and (*b*) eventually to explore the original home of Lantana in tropical America in search for additional insect enemies or diseases. The subject is one for the consideration of the Board of Forestry with the view of developing an all-India policy to be followed. In the meantime unauthorized importations of Lantana insects into India should be prohibited.

A New Genus of Fossil Sponges

A NEW genus (Protohyalostelia) of sponges discovered in lower Cambrian strata in South Australia has been described by Frederick Chapman in a paper recently read before the Royal Society of South Australia. All previous records of sponges in the Australian Cambrian have been confined to sporadic occurrences of anchoring spicules and separated sponge spicules. This new discovery is remarkable in that actual sponge bodies have been preserved with the spicular structure more or less in position. They are, therefore, the first of their kind to afford definite evidence of their taxonomic position among Lower Palæozoic sponges. In form they are cup-shaped, varying from vase-like to elongate, almost cylindrical bodies. The spicular structure shows that they belong to the Lyssakine group of the Hexactinellida. It is suggested that the present Cambrian genus, Protohyalostelia and other related ones, as Hyalostelia (Cambrian to Carboniferous) should be placed in a new family, the Hyalosteliidæ.

House-Sparrow in New Environment

IN the fifties of last century the house-sparrow, *Passer domesticus*, was set free in the United States of America and since then it has settled and flourished in the entire continental United States except Alaska. Most of the original individuals were imported from England, some from Germany, and it is a matter of interest to inquire what changes, if any, have been induced by an environment which has enforced some changes in food and in predators, as well as changes in climate. Some years ago the writer obtained a series of skins of American house-sparrows from Dr. Outram Bangs, and found that the range of variation in colour of plumage did not exceed that shown by the sparrows in Great Britain, but David Lack has submitted certain characters to the test of measurement (*Condor*, **42**, 239; 1940). The characters chosen were length of bill from nostril to tip, depth of closed bill, and length of wing (standard measurement). American sparrows were found to have on the average rather larger bills and wings than English ones; but they are not larger than German specimens, so that it would be hazardous to say that any significant change had taken place. In America itself, however, analysis by region shows that the sparrows from southern California have larger bills, as regards length and depth, than those from other regions, and they are also larger than in German sparrows, so that some variation appears to be taking place in accordance with the trend observed elsewhere, that extremities, such as bills and legs, become longer in regions of warmer temperature.

Analysis of Winter Temperature

THE *Monthly Weather Review* of the U.S. Weather Bureau of June 1940 (vol. 68, No. 6) contains a summary by C. J. Root of the winter temperatures recorded at one of the stations in America with the longest unbroken record (eighty years). The station is Marengo, Ill. The summary is made in such a way as to bring out most clearly the long-period trends, graphs being given of the five-year and ten-year averages for the winter (December–February) from 1856–57 to 1936–37. Both these graphs show a decline from initial warmth to a minimum for the period ending with the winter 1885–86, and then a recovery to more than the initial warmth. Thus the five-year mean for the period ending in February 1886 was only just above 18°F. and that for a similar period ending in February 1932 was more than 25° F. This winter mildness of recent decades is shown not to be due to a change in the site of the instruments; it is in agreement with the trend at many other places in America as well as in Europe.

Crustal Structure of the United States

TWO papers presented at the Cincinnati meeting of the Eastern Section of the Seismological Society of America on May 31 and June 1, 1940 (*Earthquake Notes*, **12**, Nos. 1 and 2; September 1940), are important in that they suggest a different structure in the United States from that determined previously for certain other regions in the world. The first paper is by Henry F. Birkenhauer, *S.J.*, and concerns the Illinois Basin earthquake of November 23, 1939, with epicentre near Redbud, Illinois. The velocities of seismic waves determined from records from thirteen observatories were found to be $\overline{P}$ 5·9, $\overline{S}$ 3·3, P^* 6·6, S^* 3·9, P_n 7·3, and S_n 4·1, all km. per sec. To fit the seismogram readings the author suggests an upper layer 26 km. thick and an intermediate layer 12 km. thick above the Mohorovicic discontinuity. The second paper, by Edward J. Walter, concerns "Earthquake Travel-Times and Structure South of St. Louis". Six local earthquakes were studied, and the structure suggested consists of three layers above the substratum. From the top downwards the author suggests layers 5 km., 20 km. and 12 km. thick and velocities of P 6·03, 6·33, 7·19 and 7·73 km./sec. respectively, and of S 3·63, 3·74, 4·08 and 4·40 km./sec. respectively in these layers and the substratum. The improved or new teleseismic stations mentioned by N. H. Heck of the U.S. Coast and Geodetic Survey at the same meeting, namely,

those at Burlington, Vt.; Pittsburgh, Pa.; Columbia, S.C.; Des Moines, Iowa; Logan, Utah; Reno, Nev.; and Ukiah, Cal., should prove exceedingly useful, along with stations already existing, in testing the above hypothesis.

Determination of the Depth of Glacial Deposit

A SERIES of seismic profiles has recently been run in the Riverside Section of the town of Weston by L. D. Leet and T. J. Smith, *S.J.* (*Earthquake Notes*, **12**, Nos. 1 and 2; September 1940). Using the seismic exploration unit belonging to the Humble Oil Company of Houston, Texas, the authors showed the average depth of glacial deposit in the area to be approximately 100 ft., increasing to 250 ft. in the pre-glacial valley of the Charles River near by.

A New Fine Oil

IN view of the difficulty which is now experienced in obtaining from the usual sources supplies of clock oil or Jouvain oil suitable for use as a lubricant for many precision and other instruments and for light machines, it is of special interest to learn that a new product has been introduced to take its place. This new lubricant, which is referred to as Clock Oil R.304, has been evolved by Messrs. Stafford Allen and Sons, Ltd., of Wharf Road, London, N.1, working in conjunction with the chemists of the Admiralty Research Laboratory, and has secured the approval of the latter. A sample which has been submitted for inspection shows a preparation possessing the physical and chemical properties requisite for the purposes indicated, while the fact that it has passed all the stringent tests required by the Admiralty Research Laboratory carries the assurance of its suitability for use with instruments under normal conditions of service. The makers offer to answer further inquiries as to the characteristics of the oil.

Softening Point of Glass

AT a meeting of the Society of Glass Technology held on November 20, J. T. Littleton presented a paper on the above subject. Two definitions of softening point are at present in use. According to Dr. Littleton, it is that temperature at which a fibre of glass, 9·25 in. long, of a diameter between 0·55 and 0·75 mm., suspended vertically in a furnace of specified characteristics, will elongate under its own weight at the rate of 1 mm. per minute. Under these conditions such a rate of extension takes place when the glass has a viscosity of $10^{7\cdot6}$ poises. The second definition is that agreed on by the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft, and is the maximum point reached on the complete thermal expansion curve of a glass. Again this point is dependent on the experimental conditions, and the apparatus employed has to be standardized before a definite viscosity value can be allocated to the point so determined. The two methods were then described and the results obtained by them compared. The fibre-extension method was claimed to give results precise to better than one degree, whereas the interferometer method is not so precise. The latter method is based on the measurement of a temperature at which an effect having no magnitude occurred, whereas the fibre-extension depends on measuring the temperature at which the magnitude of the effect has a definite value. Softening point determinations are a rapid and reliable means of ascertaining if any variation in the characteristics of a glass has occurred. The fibre-extension method has been in use at Corning Glass Works, U.S.A., for more than thirty years, and during the last few years about ten thousand measurements a year have been made.

Atmosphere of Venus

DR. R. WILDT makes an interesting suggestion as to the chemical constitution of the clouds which are observed on the disk of the planet Venus (*Astrophys. J.*, **92**, 247; 1940). The atmosphere of the planet is at present spectroscopically free from water vapour but rich in carbon dioxide, and is filled with white clouds the nature of which is still unknown. Dr. Wildt makes the assumption that the primordial atmosphere was one mainly of carbon dioxide, but containing small quantities of water vapour. A photochemical reaction between these constituents when they are illuminated by ultra-violet sunlight will produce formaldehyde, the oxygen so released being chemically absorbed by the surface layers. Moist formaldehyde gas rapidly polymerizes into a mixture of solid white polyoxymethylene hydrates $(CH_2O)_x.H_2O$, which, it is suggested, constitute the observed clouds. The vapour pressure of formaldehyde in equilibrium with the solid polymers is small, so that the ultra-violet electronic absorption bands of the gas will not be expected to appear, as Dr. Wildt indeed finds from his observation of the spectrum of the planet. The vapour pressure of the polymers themselves is of the right order at the temperature of the Venusian atmosphere to allow of the formation and dissolution of clouds by the processes of condensation and sublimation. An attractive feature of the theory is that its basic assumption as to the primordial constituents of the atmosphere accounts for the present lack of free oxygen on the planet.

Absorption of Light by Interstellar Matter

THE solutions of many problems of stellar distribution in our galaxy depend on the value assumed for the mean coefficient of absorption of light by interstellar matter. Many investigators have in fact used such a mean coefficient without making a critical examination of its validity for the purpose in hand. Doubt is now thrown on the legitimacy of this procedure by Stebbins, Huffer and Whitford (*Astrophys. J.*, **92**, 193; 1940). From their recent investigation of the colours of 1332 *B*-type stars near the galactic plane and out to 2,000 parsecs from the sun, they conclude that the effect of the interstellar material is too irregular to be represented by a mean coefficient of selective or of total absorption. Even when taken over such a limited region of the sky as one 10° square, the values of colour excess obtained for stars of the same spectra and apparent magnitude (that is, for stars at approximately the same distance) show such a large dispersion that the authors are forced to postulate the existence of small clouds of obscuration. No reasonable treatment of the data can make the star colours fit relations in which absorption is put proportional to distance. An attempt to remove from the data the effect of the more obvious clouds leads to a decrease in their mean coefficient of selective absorption from 0·17 mag. per kiloparsec to 0·12; but, as the authors point out, their exclusion of abnormally reddened stars is arbitrary and results in a coefficient the physical significance of which is scarcely less open to criticism than that of the original one.

EDUCATION OF WORKERS IN APPLIED PHYSICS*

By Dr. H. Lowery,

Principal of the South-West Essex Technical College, Walthamstow

In observing the rapid growth during recent years of large industrial research organizations which have for their declared object that of producing advances in industry and commerce, we are apt to be tempted to think that the relationship between science and industry is something peculiarly modern, whereas in point of fact it dates back to the dawn of communal life. Actually all that has happened is a quickening of the pace of what is but a natural interaction between the acquisition of new knowledge and its application to human needs. When once man had learnt some new fact by his trial-and-error methods, say in the handling of metals, he proceeded immediately to turn the discovery to his advantage, thus extending the range of application of his material and its general utility. Just so, the continued improvement of the products of modern industry and the evolution of new industries are due to the successful application of recently acquired ideas and the development of improved techniques and processes of manufacture. The interesting point to note, however, is that we no longer rely upon the crude method of trial and error, fruitful as this method was in the past; on the contrary, most industrial advances are the result of the deliberate application of the scientific method. The rapidity of the advances is due to the existence of a great co-operative effort between those who practise a given industry and those who endeavour to discover new facts, principles and practical possibilities. Discoveries are thus no longer left to chance, and though they cannot be made to order at least we can ensure that existing knowledge is put to the best possible use and the ground carefully cultivated by systematic observation and experiment so as to favour the growth of new knowledge.

That the relation between the acquisition of knowledge and its subsequent application to the satisfaction of human wants is perfectly natural in character and that the discoverer and the practical man are therefore on an equal footing has unfortunately too often been overlooked in the past, with the result that there has frequently arisen an attitude of superiority on the part of the discoverer towards the manual worker, followed by a curious superiority of attitude of the academic research worker towards the technologist or scientific worker who deliberately aims at applying knowledge in the fields of industry. Happily this type of snobbery is gradually being broken down, but where it still persists it is a constant source of irritation to the people concerned and leads to regrettable industrial inefficiency.

In view of the splendid successes already achieved by industrial research laboratories in developing old-established industries and inaugurating new ones, the recognition of the professional scientific worker as an essential part of the industrial organization seems assured. Hence arises the educational problem as to the best kind of training to enable him to play his part to the full in the new scheme of things. Not less important is the necessity for making the ordinary employee scientifically minded at least to the extent that he may be led to co-operate freely in the industrial changes dictated by scientific investigation. This in turn demands of the scientific worker personal qualities such as will enable him to strike a bond of friendship with the worker in the factory, thereby inspiring a spirit of co-operation helpful alike to present production and future developments.

It is important that all industrial workers should realize that the man of science has much of value to say not only on material matters but also on the many human problems that arise daily in the modern factory; the view that the man of science is a narrow specialist must be combated until it is entirely removed and confidence engendered so that his opinion and advice may be freely sought when difficulties arise either in the works or among the staff. Moreover, it is worth while pointing out that Governments can no more dispense with the aid of the scientific worker than can industrial undertakings.

The demands made by industry upon scientific workers are so diverse that it has long been found necessary for those workers whose interests are somewhat related to form themselves into groups for the pooling of knowledge, the interchange of ideas, and the discussion of problems arising from their employment in industry. In this way many learned societies and professional organizations have come into being. The latter have usually emphasized the personal relationships between the scientific worker and industry, and have quite naturally been concerned with determining the most appropriate form of training to enable their members to render effective aid to industry. For a variety of reasons (into which we need not enter here) professional organizations for engineers and chemists were established long before that for workers in applied physics; but in 1918 the Institute of Physics was founded with the object ". . . of the elevation of the profession of physicist and the advancement and diffusion of a knowledge of physics, pure and applied, and for this purpose especially: To promote the efficiency and usefulness of its members by setting up a high standard of professional and general education and knowledge, and by compelling the observance of strict rules of personal conduct as a condition of membership".

The foundation of the Institute came at a most opportune time, for the results of a period of unprecedented activity in physical research were beginning to find their practical applications, with consequent rapid expansion of industrial enterprise.

The Institute began by enrolling physicists of approved status and was thus able to form a panel of

* Based on a paper read before the London and Home Counties' Branch of the Institute of Physics on October 26. (The views expressed here are not necessarily those of the Institute of Physics.)

consultants which has been of invaluable assistance to industry. Lectures on "Physics in Industry", given by eminent industrial physicists, not only provided much-needed surveys of the achievements of physics in various industrial processes but also prepared the way for new advances by suggesting fresh lines of research in applied physics. The scope of the activities of the Institute was greatly widened by the formation of branches, the first of which began in Australia and India. In 1931 a local branch was formed in Manchester. This was quickly followed by a Midland Branch with its centre in Birmingham, and later (1936) by the London and Home Counties' Branch.

By means of the local branches the Institute is able to provide for the 'continued education' of its members; up-to-date surveys of recent advances in pure and applied physics are given at the branch meetings by various specialists; conferences and exhibitions on the applications of physics are arranged, and facilities provided for social intercourse among the members, so furnishing the means for the exchange of ideas between workers from different industries.

It is perhaps natural that the standards for admission to full membership adopted by the Institute were based on those of the universities, for at the time of the inception of the Institute these were the only standards easily definable, namely, an honours degree in physics coupled with some post-graduate training. Subsequent experience derived mainly from observations on the employment of physicists in large industrial laboratories seems to show that other standards of assessment of the status of the physicist may now be applicable. For example, in view of the overlap of the work of the physicist into the fields of biology, chemistry and engineering, a training in 'general' scientific subjects is found by many organizations to provide the most suitable preparation for the young physicist, together with some later appropriate specialist technical training.

Opinions differ as to whether the young physicist should carry out post-graduate training in the university before entering industry, or whether he should go direct into the industrial laboratory, or even whether his degree training should not perhaps be modified by some preliminary contact with the works. If one may judge by the reports given by directors of industrial research at the Conference on the Training of Industrial Physicists held by the Institute in February 1936[1], it would appear that each industry has its own individual preferences on these points. Moreover, the position in the United States does not seem materially different in this respect[2]. Nevertheless, given a certain approved minimum training, all employers emphasize the importance of the possession of those personal qualities which will not only enable the research worker to work amicably with those in the factory but will also help him to express the results of laboratory investigations in such a way that they will be acceptable even to those whose long experience in industry has rendered them almost impervious to anything that breaks with tradition.

We may note that industry now employs large numbers of young people who proceed directly into the works at the end of their school careers, a fair proportion of whom develop into highly valued workers in applied physics. They attend part-time day or evening classes at their local technical college and ultimately obtain a degree or professional diploma and possibly even a research degree as well[3]. It is gratifying that increasing numbers of employers are willing to co-operate with the local colleges by releasing their junior employees for several half days' college work per week, and there seems to be no reason why this practice, at least in normal times, should not become universal. The benefits to the student are immeasurable and in the end it is unlikely that the firm would be the loser; indeed, some large firms testify highly to the value of the product of such a 'sandwich' system[4].

The technique of teaching has now reached such a point that we can almost 'teach anyone anything'; certainly we have little to learn regarding the art of getting people through examinations, and yet this does not guarantee that those who are coached successfully even to the taking of the highest academical honours shall be of more than average value in industry. Indeed, one physicist[5] has seriously asked whether "we are not actually harming some of our best men; lessening their vitality, delight in their work, and common sense by too efficient a system of training them to answer the questions we set in their examination papers".

When we come to the consideration of the content of the physics course we are again faced with the problem that individual firms often expect their own special requirements to be catered for. Despite the fact that it is impossible to produce a course of training that will meet every demand, there are certain general matters that any well-balanced course should provide, namely, a readily applicable mathematical equipment; some practical acquaintance with workshop processes such as turning and glass-blowing; the uses of industrial instruments such as the spectrometer, polarimeter, microscope, camera, thermionic valve and oscillograph; some acquaintance with the general principles of instrumental design; a knowledge of how and where to find technical information; and a reasonable command of the English language, both spoken and written. Complaints have often been made (quite justifiably) by employers that such general things as these have often been neglected in favour of an overdose of atomic physics.

War-time is perhaps not the best time for making changes; but it is pleasing to note that industry, the universities, technical colleges and the professional organizations are alive to the problems involved in the training of young recruits for industry, and we may reasonably hope to see very substantial and beneficial modifications in the training of all scientific workers when the time is ripe. At the outbreak of war we were on the eve of great developments in technical education heralded by the establishment of a new type of college with ample provision for social and cultural interests in addition to the requirements of vocation. It is to be hoped that these developments are merely postponed, for there can be no doubt that they are calculated not only to ensure an adequate flow of enlightened technologists into industry but also to produce a supply of scientifically and socially minded men fit to be leaders in the great period of world reconstruction.

[1] Crowther, J. A., "The Training of Industrial Physicists" (*J. Sci. Inst.*, **13**, 141; 1936).

[2] Hardy, A. C., "The Physicist in Industry" (*Amer. J. Phys.*, October 1940).

[3] Owen, D., "The Teaching of Physics in Technical Institutions", Reports on Progress in Physics, **6**, 431 (Physical Society, 1939).

[4] Fleming and Pearce, "Research in Industry", p. 168 (1922).

[5] Bragg, W. L., "Some Views on the Teaching of Science" (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, **72**, 119; 1927).

APPLIED BIOLOGY IN WAR-TIME

A WELL-ATTENDED and representative meeting of the Association of Applied Biologists was held at Harpenden on December 6 under the presidency of Mr. C. T. Gimingham to discuss the function of applied biology in war-time. In the opening paper, Sir John Russell dealt with the three general groups of problems to which applied biology can usefully contribute: maintenance of public health during the War; protection of food and other materials, for example, wood, flax, etc., both in the field and in store against deterioration by biological agents; and increase in the amount of food supplies.

While the maintenance of public health is primarily the business of the medical authorities, applied biologists can render valuable assistance in the adequate cleansing of shelters and of the persons and property of evacuated people. Much of the difficulty of finding accommodation in reception areas is due to the fear that insects and diseases may be brought from the cities into clean country homes, as actually happened in the first evacuation. It is, however, chiefly in connexion with food supplies that applied biologists are usually concerned, especially with food protection. The average dietary in Great Britain is both varied and attractive, but it cannot be maintained in war-time; a much simpler diet is necessary involving less meat, butter, eggs and sugar, but more potatoes, vegetables and bread. Of this new dietary we can produce far more than the 40 per cent of pre-war days: already the figure is well above this and will, it is hoped, be still higher. But the new programme necessitates the conversion of grass land to arable, and various members of the grass land population need controlling. Wireworms do much damage to wheat and other cereals. In the War of 1914–18 no adequate control measures were found, and unfortunately only a moderate amount of investigation was made in the peace period, so that we are still in much the same position as in 1918. Two fungi injurious to wheat have come into prominence since the War of 1914–18: *Ophiobolus graminis* and *Cercosporella herpotrichoides*: the former is harmful on light rather alkaline soils, and the latter is encouraged by the nitrogenous manuring now being enjoined on farmers. The potato crop is liable to a considerable number of pests and diseases, but some of the worst, for example Phytophthora blight and wart disease, can be dealt with. The virus diseases are now the most troublesome; fortunately they are now being vigorously studied. In the meantime they can be avoided only by the use of virus-free seed, but this is not always convenient.

For animals it is necessary to provide more protein equivalent, as the quantity produced on the farm tends to be reduced by ploughing out. Beans would furnish useful supplies, but are liable to attack by aphids. Marrow stem kale is an excellent transformer of simple and easily obtainable nitrogen compounds into protein equivalent, but it may suffer badly from the turnip flea beetle. Fuller control measures are desirable.

Considerable help has already been rendered, however, by applied biologists in saving crops and also the finished products milk and meat. Cleaner milk is now realizable in practice, and bacteriological control is understood and appreciated by many farmers; while valuable service has been rendered in regard to the control of the sheep blowfly and the tick *Ixodes ricinus*, which causes louping in sheep. The storage of food presents numerous problems now happily far better understood than in the War of 1914–18.

The investigation of war-time problems will necessitate numerous studies and surveys which, it it hoped, will be so planned that the results can be subjected to statistical analyses. Little more trouble is involved, and the value of the work is greatly enhanced.

Two food production activities come within the scope of applied biologists. Honey production is capable of much expansion in Great Britain: already about one million pounds' worth is produced annually, but bees render even greater service than this in the pollination of fruit trees and certain other plants. The other problem is not so well advanced. During the War of 1914–18 the Germans were said to be using a yeast for the production of protein and fat for human consumption. It is hoped we shall not need to do this; but it would be of the greatest value if some process could be worked out for synthesizing protein for animals. Suitable nitrogen compounds are available, but the substrate presents difficulties; various wastes might be used, but the ideal source of carbohydrate would be straw, which is available in particularly large quantities on most farms.

These are the main problems: the question is how best to organize the activities of applied biologists so as to ensure finding some solution now, and continuing the work after the present war is over.

In the discussion Prof. J. W. Munro, Mr. J. C. F. Fryer and others emphasized the fact that the war-time biological problems of to-day include many of those of the War of 1914–18, and if we had continued work on them during the past twenty years with the same impetus we should now have been in a much happier position. There was also the old difficulty of ensuring that existing knowledge should be fully applied in practice. Mr. Fryer instanced leather jackets, which had damaged thousands of acres of crops, and the white cabbage butterfly, which last year caused much loss, both of which could have been controlled. It was, however, more difficult to forecast outbreaks in Great Britain than on a Continental area. Mr. Findlay spoke of the serious wastage of sandbags because certain known precautions had not been taken.

It was strongly urged by Drs. Blackman, Ainsworth, Barnes and others that biological experts are not being fully drawn upon at the present time, and on the motion of Dr. Goodey and Mr. Fox-Wilson the Council of the Association of Applied Biologists was asked to bring to the notice of the appropriate bodies the pressing problems which exist to-day in applied biology and to discuss with them the means of utilizing to the best advantage the services of applied biologists.

COSTS OF ELECTRICAL HEATING

IN *Electrical Industries* of November, Mr. F. D. Parker criticizes methods of measuring the running costs of electricity when used for heating and cooking installations. If the estimates given are too high, the company loses a valuable load; and if too low, there is often dissatisfaction and complaints. In particular, the estimating of 'space heating' loads is especially difficult owing to the fact that so much depends on many undeterminable factors.

Weather conditions are very closely related to energy consumption in much the same way as the amount of hot water used determines electric water-heating consumption. The main difficulty is that whereas the latter can in some measure be computed, the former is always conjectural. It has also to be remembered that running costs of heating installations in the south of England cannot be considered representative of those in the north, where more severe weather conditions are experienced. This emphasizes that data obtained from other installations, when not in the same locality, must be employed with caution.

Further factors influencing space-heating consumption are: type of building, position, heat-loss characteristics, hours of use, time of use and thermostat setting. The provision of revolving doors, springs on doors to exclude draughts, and the system of ventilation adopted, if any, all appreciably affect operation costs. It follows that the estimating of space-heating consumption is a much easier matter when dealing with existing buildings than from plans of buildings to be erected. In the latter case, allowance has necessarily to be made for the drying out of buildings during the first year.

In the domestic sphere, estimating space-heating consumption is very conjectural, as the element of careless usage is always present. This, coupled with variations in consumers' habits and ideas as to the amount of heat required, usually prevent space-heating consumption of one consumer being considered representative of other consumers even of identical characteristics. Apart from all-electric houses, etc., the majority of domestic space-heating consumers may be considered intermittent users. No difficulty therefore is likely to arise if consumers are advised of the consumption of the apparatus on various 'heats'—which should be done when appliances are purchased, especially from supply authorities.

With new all-electric consumers the position is somewhat different. Apart from thermostatic control and continuous heating, running costs are proportional to hours of usage, which often cannot be determined. If consumers therefore require some idea of annual space-heating costs, then the only arrangement is to obtain from them details as to probable usage and build up estimates accordingly, assuming $\frac{1}{2}$–$\frac{2}{3}$ of the total loading of the heating apparatus is in use per hour. In regard to the heating of corridors, halls, etc., much depends on the type of apparatus installed and the method of control. It is advisable to eliminate hand control as much as possible, as apparatus employed for such purposes is apt to be neglected.

The calculation of operation costs on a heat loss basis for direct heating, assuming, for example, minimum outside temperatures of, say, 25–30° F., to maintain 60° F. internally, to obtain the required loading, and then assume average winter temperatures of, say, 40–44° F. and arrive at the consumption accordingly, relatively to the hours of usage, heating-up times, etc., should provide reasonable estimates. The trouble is that theoretical heat-loss calculations of buildings seldom hold good in practice, owing to faulty construction, badly fitting windows and doors. Weather conditions such as effects of sun and wind should be taken into account.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

INSPECTOR (WOMAN) OF SCHOOLS, and an ADMINISTRATIVE ASSISTANT (MAN)—The Director of Education, Education Offices, Leeds 1 (December 31).

PRINCIPAL OF THE ROYAL TECHNICAL COLLEGE, Salford—The Director of Education, Education Office, Chapel Street, Salford 3, Lancs. (December 31).

GRADUATE ASSISTANT TEACHER FOR MECHANICAL ENGINEERING SUBJECTS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (January 6).

ASSISTANT MASTER OF MISTRESS FOR SCIENCE (mainly Mechanics, Heat and Chemistry)—The Acting Principal, Technical Institute, Sheerness.

ASSISTANT ENGINEER FOR THE DRAINAGE AND IRRIGATION DEPARTMENT, Malaya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9316).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

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British Museum (Natural History). Economic Leaflets, No. 6: Plaster Beetles. Pp. 4. (London: British Museum (Natural History).) 1*d*. [1811

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 23: An Analysis of the Influence of Weather upon a Migratory Movement of Birds. By Prof. James Ritchie. Pp. 299–321. 2*s*. Vol. 60, Part 3, No. 24: Early Glacial Remains of Reindeer from the Glasgow District. By Dr. M. Macgregor and Prof. James Ritchie. Pp. 322–332. 1*s*. 3*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [2011

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The Hilger Photometric Colour Comparator (an "Abridged Spectrophotometer") with a description of the Hilger Photometric Amplifier. (SB. 289.) Pp. 8. (London: Adam Hilger, Ltd.)

Various Books, also a Complete Set of Gould's Birds. (Catalogue No. 652.) Pp. 68. (London: Francis Edwards, Ltd.)

Early Botany and Herbals, Old Medicine and Science. (Catalogue 60.) Pp. 54. (London: E. P. Goldschmidt and Co., Ltd.)

Diary for 1941. Pp. 16+32 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

NATURE

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Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London

The annual subscription rate, Inland and Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to

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Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
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Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, DECEMBER 28, 1940 No. 3713

CULTURAL SIGNIFICANCE OF SCIENTIFIC METHOD

FEW things have contributed more to consolidate the unity of the nation and to fortify its resolve to persevere until victory is achieved than the realization that the present struggle is between two fundamentally opposed ways of living—between an order in which the individual is crushed and in bondage to a monstrous conception of the State, and an order in which personality is respected, the great traditions of Western civilization are cherished and the human spirit is free to enrich that heritage by further creative work in art, in literature, in science and other spheres of culture and thought.

Although democracy and totalitarianism are fundamentally opposed ideals, we should not make the mistake of assuming that the democracies have nothing to learn from the totalitarian regime. On the contrary, it is of the utmost importance that there should be a clear understanding of the causes which led to the rejection of democracy, and the emergence of the totalitarian States during the two decades following a war which was to have made the world safe for democracy. Unless we are willing in these fields also to learn from our opponents and to seek to eradicate the weaknesses of democracy as they are brought to light, we may once again experience the frustration which followed the War of 1914–18.

"The serious threat to our democracy is not the existence of foreign totalitarian states. It is the existence within our own personal attitudes and within our own institutions of conditions similar to those which have given a victory to external authority, discipline, uniformity and dependence upon the Leader in foreign countries." This warning of John Dewey in his recent study of "Freedom and Culture" (London : Geo. Allen and Unwin, Ltd., 1940. 7*s.* 6*d.*) is the more timely when there are already appearing articles even in the technical Press attributing our economic troubles to State interference with private competitive effort for gain, and advocating an immediate return to untrammelled *laissez faire.*

Whatever may be the nature of the social and world order after the War, it is certain that a return to the position of August 1939 with a minimum of disturbance is both illusory and dangerous. To desire no nobler prospect than a perpetuation of the disparities and injustices, the inertia and complacency of the period 1918–39 is a Maginot complex in the social realm, and treason to the spirit which the nation has displayed in the last nine strenuous months. A hide-bound persistence in methods and doctrines which were sound enough fifty or a hundred years ago may easily prove as costly in the financial, economic and social field as in the field of actual warfare. It might not lose the War ; it would almost certainly once again lose the peace.

A foremost need is an unprejudiced review of conditions as they are now and as they are likely to be after peace has been won, with an open and unprejudiced mind, ready to accept any changes which are shown to be necessary, however unpalatable, and to abandon any preconceptions, however deeply cherished, which have become unpalatable. Even this, however, is not enough. If we are to build an enduring order we must go even deeper. We must establish right relations between democratic institutions and human relations, with all that is understood by culture in the truest and widest sense of the word.

Democracy, as Sir Richard Livingstone has reminded us, like patriotism, is not enough. It is indeed a way of life and it affords men the best opportunity of leading the good life; but it is no guarantee that they will lead it. We have yet to realize that democracy is a way of personal life and one that provides a moral standard for personal conduct. Unless we can find that moral power, both the value and the very existence of democracy are in peril.

It is well that there should be no mistake as to the tremendous moral or even religious challenge thrown down to democracy at the present time. That internal challenge must be met if the external threat of the totalitarian States is to be overcome, and in his study of freedom and culture Prof. Dewey leaves no room for complacency, for all his confidence as to the ultimate issue. That will be assured so long as we face our problems in detail as they arise, with all the resources provided by collective intelligence in co-operation.

This question of the relation of freedom and democracy to culture involves not merely spiritual and moral issues but also those of science. As Prof. Dewey points out with respect to means for understanding social events, we are still living in the pre-scientific epoch, although the events to be understood are the consequences of the application of scientific knowledge to a degree unprecedented in history. It is this that gives such significance to Mannheim's recent attempt to develop a theory of planning for freedom and the technique of social control. No democracy has ever made complete or adequate use of scientific method in deciding upon its policies, although freedom of inquiry, toleration of adverse views, freedom of communication, and the distribution of what is discovered to every individual as the ultimate intellectual consumer, are involved in the democratic as in the scientific method.

Prof. Dewey's reminder of the potential alliance between scientific and democratic method is indeed timely, and not irrelevant to the organization of our war effort as indicated in a recent leading article (see NATURE, Oct. 12, p. 469). When democracy openly recognizes the existence of problems and the need for probing them as problems as its glory, political groups which refuse to admit incompatible or unpalatable opinions will be relegated to the obscurity which is already the fate of such groups in science.

Prof. Dewey has more to say about the interaction of science and society to-day and its relation to the future of democracy. One of the most stimulating chapters of his book is that in which he discusses the relation of science and free culture. We can no longer assume that the assured advance of science will lead to free institutions by dispelling ignorance and superstition. Some of the new powers with which science has endowed mankind, such as the radio and the Press, have proved potent tools of oppression and servitude. The question is raised whether science, like propaganda, can shape ends.

Prof. Dewey gives an admirable survey of the different points of view from which are approached the questions of the extent to which the shaping of science, and the determination of the direction of its advance, are determined by the social environment, and the social responsibilities of the scientific worker. This leads him not merely to raise the question whether a democratic society can exist without regulation, exercised by a public authority on behalf of social unity, of scientific pursuits, but also whether it is possible for the scientific attitude to become such a weighty and widespread constituent of culture as to shape human desires and purposes. This latter question involves the direct issue of the kind of culture in which scientific method and scientific conclusions are integrally incorporated.

It may be argued that one of the reasons why men have been willing to accept conclusions derived from science in place of older ideas has been their serviceability in some aspect of culture or industry. On this ground we might well hold that the kind of serviceability which is capable of generating the highest esteem for science is serviceability for social welfare. The development of economic and agricultural policy in post-War Europe to secure the maximum utilization of scientific knowledge of nutrition might be an important factor of this type in one special field.

The influence of science upon both means and ends is not exercised directly upon individuals but indirectly through incorporation within culture. Moreover, science is not simply a body of conclusions; even more important from a cultural point of view, science is an attitude of mind which resolutely employs certain methods of observation, reflection and test. Scientific inquiry indeed has a morale of its own, including willingness to hold belief in suspense; ability to doubt until evidence is obtained; willingness to proceed on evidence rather than on a personal preference; ability to hold ideas in solution and use them as hypotheses

to be tested instead of as dogmas to be asserted; and the enjoyment of new fields for inquiry and of new problems.

As Prof. Dewey points out, each of these traits is contrary to some embedded impulse, and accordingly the mere existence of the scientific attitude and spirit is evidence that science has created a new morale—equivalent to the creation of new desires and new ends—and is capable of developing a distinctive type of disposition and purpose. This service of science may far outweigh its serviceability in the social field. The development of a scientific outlook is of fundamental importance for the preservation of democracy, and the transformation of educational content and method to encourage that development and not the mere inculcation of scientific facts is one of the most pressing problems in education to-day. The fate of democracy is bound up with the spread of the scientific attitude. More important even than the contribution of science to the solution of immediate and practical problems, the scientific attitude is the sole guarantee against wholesale misleading by propaganda. It is the only assurance of the possibility of a public opinion intelligent enough to meet present social conditions.

The democratic extension of the scientific morale in this way until it is part of the usual equipment of the ordinary individual involves moral problems also. The scientific worker must acknowledge his moral responsibility for wider communication of the results of his work to others besides those engaged in specialized research. The need, however, is not for scientific men to become crusaders in special practical causes. It is recognition by scientific workers of their social responsibility for contagious diffusion of the scientific attitude.

That task will not be achieved without abandoning once and for all the belief that science is set apart from all other social interests as if it possessed a peculiar holiness. Without sacrificing professional standards, we must find means of securing that the influence of science and respect for its followers are based, not on a sense of mystery or something apart, but on firm understanding of its outlook and ways of working. Much more than the mere dissemination of the facts ascertained in different branches such as physics, chemistry, biology, geology and the like is required.

Science, through the physical consequences of its technical applications, is determining the relations of human beings, whether individually or in groups, one with another. If it is incapable of developing moral techniques which will also determine these relations, the rift in modern culture may involve the doom of democracy and all the values of civilization. Whether science is capable of influencing the formation of ends for which men strive, or whether it is limited to increasing their power of realizing aims which are formed independently of science, depends on the intrinsic moral potentiality of science. A culture which permits science to destroy traditional values but distrusts its power to create new ones, is a culture which, as Dewey remarks, is destroying itself.

The contribution which science can make to the war effort and to the reconstruction which must follow the War in the physical and material realm is gradually becoming more widely appreciated, even if we have far to travel before its full measure is realized. The chief merit of such publications as "Science in War" (see NATURE, July 27, p. 112) is indeed the way in which they direct attention to such possibilities and stimulate thought in that field. The contribution which science can make in the cultural field is equally important but far less widely appreciated even among scientific workers themselves. Prof. Dewey's little study is accordingly the more timely and welcome. If scientific workers are stirred by it to think more deeply upon such issues and to concern themselves with this question of diffusing the scientific outlook, they may well make an all-important contribution both to winning the War and building the peace to follow.

Science requires a tradition of freedom of thought, investigation and teaching such as is inherent in a democratic system, if it is to flourish and exert its creative powers; in the same way, democracy has no less need of the spirit and work of science. While cherishing individual freedom and initiative, the whole democratic system must be rigorously scrutinized; we must approach it in an unprejudiced scientific manner, showing ourselves willing to discard whatever is outworn or has served its purpose, ready to learn even from its opponents and to take pains to incorporate new methods or new ideas while safeguarding those to which its own vitality is due. The fundamental thinking which is a prelude to a closer alliance between democracy and science, as a condition of a new and richer world order of freedom and plenitude, must be undertaken now. It may well issue in an era of creative thought and power in science no less than in those other branches of culture of which democracy is alike nurse and champion.

WEATHER AND WEATHER PROPHETS

(1) Weather Prediction
By Major R. M. Lester. Pp. 256. (London: Hutchinson's Scientific and Technical Publications, 1940.) 10*s*. 6*d*. net.

(2) Forecasting Weather
By Sir Napier Shaw. Third edition, with a Supplementary Note on Sixteen Years' Progress in Forecasting Weather, by R. G. K. Lempfert. Pp. xliii + 644. (London: Constable and Co., Ltd., 1940.) 42*s*. net.

THESE two books deal essentially with the same problem, that of forecasting to-morrow's weather, but they will appeal to different classes of readers. According to the publisher's note on the cover, Major Lester's book combines the functions of supplying the serious student of meteorology with an introduction to the deeper study of the subject and of supplying the amateur forecaster with an infallible guide. Some experience of trying to forecast to-morrow's weather has, however, convinced the present reviewer that no infallible guide to forecasting can be provided, either for the professional or the amateur meteorologist. Sir Napier Shaw has produced a third edition of his "Forecasting Weather", which appears to be intended for the scientific student of the subject. It is, perhaps, not unfair to say that while Major Lester has described the observed phenomena and their associations, Sir Napier Shaw has endeavoured to describe and to explain the phenomena in which he is interested.

(1) Major Lester's book is intended for the general reader who takes an intelligent interest in the weather, without having any specialized scientific training. It describes the national and international organizations in meteorology, the instruments and methods used at the observing stations, the codes used for reporting to the central office, the representation of the observations on synoptic charts, together with graphical methods for representing local observations, and comparing them with the conditions over a wide area. All stages up to the drawing of the synoptic chart are described clearly, but the reader does not gain from this book a clear conception of the use of the synoptic chart for the specific purpose of forecasting to-morrow's weather. Much information is given on the occurrence of certain types of weather; but it is doubtful whether the average reader will be able to absorb this information without some connecting threads of explanation. There are some very attractive cloud photographs, with very clear descriptions of the weather conditions in which such clouds occur. A chapter headed "Weather Forecasting" is, surprisingly, devoted to long-period weather forecasting, mainly by the use of cycles, and to weather maxims, from neither of which is the author able to draw much comfort. Later chapters survey the climates of the world and the variations of climate since the last Ice Age, and a final chapter is devoted to weather in war-time, with special reference to air-raid weather. The march of events since this book was written has modified some of our ideas on the subject of weather in war-time.

Anyone who reads through Major Lester's book will acquire a considerable knowledge of the facts which have been accumulated concerning the weather, but he will also unfortunately acquire some rather questionable ideas. When the author states "it is now believed that the secrets of the weather lie above the 20-mile limit", he deviates widely from the accepted opinion of meteorologists. He mentions the close correlation between the levels of Victoria Nyanza and the sunspot numbers, shown by Brooks to be very close over a little more than one sunspot cycle, without adding that the correlation disappeared almost completely in subsequent cycles. Major Lester quotes from an eminent meteorologist the statement "we are now in a period of decreasing solar radiation"—a statement which it is possible neither to prove nor to disprove. We are told that below 72,000 ft. will be found only a small fraction of the ozone in the atmosphere, whereas Dobson's observations indicate that, at least in middle and high altitudes, about one half of the ozone is below the limit stated. On p. 145, Major Lester states "Soviet Scientists have found how to make and disperse fog", giving an air of certainty to an achievement which is extremely doubtful. The statements to which objections are here raised take up relatively little space in the book, but they leave the impression that the vigorous use of a blue pencil would have improved Major Lester's book considerably.

(2) Sir Napier Shaw, in producing the third edition of his well-known book, "Forecasting Weather", has reproduced the second edition unrevised, asking his friend and former colleague, Mr. R. G. K. Lempfert, to write six short chapters on the progress in weather forecasting since the appearance of the second edition. As the second edition was published in 1923, the bulk of this edition may be said to represent the meteorological point of view of 1923. Meteorology has made some progress since 1923, and it would have been an

advantage to have that progress incorporated in the main body of the text, and not in chapters added at the end. But the point of view of 1923 is not without a special interest to-day. It centres upon types of weather, rather than upon the idiosyncrasies of the individual weather chart. It gives the beginnings of the development of the physics of the atmosphere, and leaves the reader with the wish that Sir Napier had devoted more space to the explanation of the physical processes of weather. The too short chapter dealing with this topic explicitly is a leisurely introduction to the functions of water vapour in the atmosphere.

It is not possible to summarize here the thirty-two chapters of this book. It does not pretend to be a systematic discussion of the physics of the atmosphere; but it covers a very wide field, so much so that essential information which we should hope to find is frequently omitted. Thus, although some sixteen pages are devoted to the discussion of barometric gradient and wind force, and the "gradient-wind" equation is given, the reader is not able to gather from this book why one solution of this quadratic equation is adopted, while the other is rejected as meaningless. On p. 241 we find the statement: "By instability in the atmosphere I mean a condition of affairs where a lighter layer is found with a heavier layer above it, so that the lighter layer breaks through the layer above and thereby causes an upward current that is violent until stable equilibrium is reached". This definition does not take account of the compressibility of the atmosphere, in consequence of which the condition for instability is, not that the density should increase with height, but that the temperature should not decrease with height at a rate exceeding a critical value of 1° C. per 100 metres. The correct definition is used in Chapter xxx. Density increasing with height requires that temperature should increase with height at a rate exceeding $3\frac{1}{2}$ times the critical value. The present reviewer cannot recall having seen a single observation of so great a lapse-rate in the free air. Sir Napier's discussion of hail gives some very interesting facts relating to the breaking up of rain drops, but we should have been glad to have the author's views on the physical causes of the structure of a hailstone, which consists of alternate coatings of clear and white ice. Sir Napier defines fog as a cloud on the ground, as also does Major Lester, and the reviewer questions the value of this definition, in view of the fact that the dynamical conditions necessary for the formation of fog and cloud are usually widely different.

The author intersperses some very pertinent facts and figures. Thus, on p. 322 he illustrates a depression, the formation of which required the removal elsewhere of 190,000,000,000 tons of air. This very illuminating figure appears to the present reviewer to afford the appropriate answer to the question so frequently asked by one's friends —"When shall we be able to control the weather"? —the answer being "When we are able to stop a mass of air of 190,000,000,000 tons from going on its own way".

There are chapters on squall lines, sea fogs, warm water fogs and thunderstorms, and a summary of the work of Shaw and Lempfert on the life-history of surface air-currents. If this chapter will only stimulate the young meteorologist to read the original memoir thus summarized, it will have served a most useful purpose. That memoir contains many fruitful ideas which have not received due attention, and others which have been ascribed to other authors. The chapter on gales and gale-warnings contains summaries of the frequencies of winds of gale force and over, with a particularly interesting list of those gales during 1908 for which no warning was issued. We should like to see more frequent detailed discussions of these forecast failures, since the first step in learning to forecast the weather of to-morrow should be explaining the weather of yesterday.

There are chapters on forecasting for aviation, coal-mining, and agriculture. In dealing with the subject of forecasting for agriculturists, Sir Napier summarizes facts concerning the distribution of temperature in hilly country which should be, but are not, familiar to every agriculturist.

The space in which Mr. Lempfert summarizes the advances made since 1923 is insufficient to do justice to those advances. He contrives, however, to give the reader a conception of the growth of ideas on the structure of the depression, as well as of the changes of procedure in forecasting and reporting. Synoptic developments are illustrated by the Daily Weather Reports for May 1, 1939, and since Mr. Lempfert has used the chart issued at Bergen on the same day to illustrate the occluded stage of a depression, we are enabled to compare charts issued by London and Bergen based on exactly the same information. The differences shown in the fronts drawn in the two services serve to show how far from being impersonal is the drawing of fronts on a chart. The utilization of upper air data in the daily work of forecasting is illustrated by the use of a tephigram, which is the form of temperature-entropy diagram used in the British meteorological service. The tephigram was first devised by Sir Napier Shaw, and has become the standard form of upper air diagram in the British service. In his last chapter, Mr. Lempfert discusses the problem of forecasting for long periods, but holds out no immediate prospect of a solution of the problem for the British Isles.

Much of the progress which meteorology has

made during the last thirty years has owed its origin to the stimulus which Sir Napier Shaw brought to the subject, with an interest which he himself describes as that of the experimental physicist, in marked contrast with the essentially statistical point of view of most of his predecessors. Indeed, his attitude is so essentially experimental, that at times he tends to shun even the simplest algebra. Algebra has its uses, and it is moreover essential in any science which aspires to be metrical. But, however much one may wish Sir Napier had chosen to model parts of his book in another form, it is, and will long remain, a book worth having and reading.

D. BRUNT.

PLACE-NAMES OF NOTTINGHAMSHIRE

The Place-Names of Nottinghamshire
By J. E. B. Gover, Allen Mawer and F. M. Stenton. (English Place-Name Society, Vol. 17.) Pp. xlii + 348. (Cambridge: At the University Press, 1940.) 21*s*. net.

IN the study of place-names, as in archæology, the interest of the early history of the county of Nottingham centres in the valley of the Trent. The one place-name which is recorded earlier than the ninth century, Tiouulfingacaestir, is identified with the Roman station of Segelocum at the point where the river was crossed by the main road from Lincoln to Doncaster; and the rock of Nottingham, which was of military importance throughout the period of the Danish War, overlooks the junction of the Leen and the Trent at the southern end of Sherwood Forest. The names of these rivers themselves, as so frequently in Britain, are relics of British settlement, and the Angles, using the rivers as their highway to Derbyshire and Staffordshire, established themselves here and there on either bank.

On the whole, however, the editors of this latest issue of the valuable surveys of English place-names point out, few place-names of an ancient type occur within the county. This indeed is not surprising in the Forest area, and the ancient word *beosuc* which occurs in Bestwood and probably in Bescar, is among the most definite among the pieces of evidence which point to an early penetration of the Forest by the English settlers in the Trent valley. Clumber and the river-names Clun, now Poulter, and Mann show that at least a small number of Britons remained in the Forest. The name Nottingham, the ham of the people of Snot, a personal name which appears again in the adjacent Sneinton in the form Snotengaham, is identified by Asser with the British *Tiggnocobauc* in reference to the ancient cave dwellings in the red sandstone hill at Nottingham; but the editors regard this as an invented Welsh name to suit the site.

The special interest of the place-names of Nottinghamshire lies in the fact that in the ninth century this region of eastern Mercia was divided among the members of a great Danish army. As the editors point out, Nottinghamshire is not one of the counties in which the results of Danish colonization appear most clearly on the modern map. The familiar mark of Danish occupation in the termination *by* appears much less frequently than in a number of other counties, and indeed there are twenty-one names only with this identification mark, as against 260 in the county of Lincoln. Closer investigation, however, brings out the fact that the series of Scandinavian village names is longer than that of any district, outside Yorkshire, which has as yet come under the observation of the survey. Widely distributed Danish personal names, compounded with *Thorpe*, such combinations as *eik-hringr* (oak-ring; eak-king), *Hrafner* or *Hrafner skialf* (the raven's shelf; Ranskill), Leake in early forms suggesting derivation from Lœkr "stream", with a number of others widely distributed, indicate the extent of Danish settlement within the county. The evidence is particularly strong in the western districts where that of Anglian settlement is weakest.

Yet there is evidence, in the modification of an earlier English name by its adoption by Scandinavian usage (Screveton; sherif's village which should have become normally Shrewton or some similar form), and in hybrid names, for example, by composition of the English *tun* with a Scandinavian personal name (Aslockton, Clipiton, Rolleston, etc.), that settlement had taken place in country well covered by English settlement before invasion began, and that these names indicate villages which became the property of a Danish owner, the English peasantry remaining for the most part unevicted.

On historical evidence it may be presumed that the population was predominnatly Danish, but the occurrence of the place-name Normanton, of which there are five examples in the county, implies settlement of the Norwegians, who predominated beyond the Humber.

An interesting light is thrown on social and funerary custom by that of Granehou among minor names (Grane's *haugr* or Grane's mound)

which occurs among parcels of land in the east field of Barnston. It was close by Granby and the names must be connected, suggesting that the *hou* is the burial mound of the man who lived at the place of which the name ends in *by*.

Of the care which has been expended in the editing of this volume it is unnecessary to speak. In its method and arrangement, it follows the plan of the recent volumes of the survey, except that in this instance the editors have been able to rely in greater degree than usual upon expert local knowledge.

TRISTAN DA CUNHA AND ITS BIRDS

Tristan da Cunha: the Lonely Isle

By Erling Christophersen. With Contributions by P. A. Munch, Yngvar Hagen, S. Dick Henriksen, Reider Sognnaes, Erling Sivertsen, J. C. Dunne, Egil Baardseth, Allan Crawford. Translated from the Norwegian by R. L. Benham. Pp. xii + 244 + 15 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1940.) 12*s.* 6*d.* net.

ON Tristan da Cunha 188 men, women and children live healthy, happy lives on what has sometimes been called the Lonely Isle—for Tristan is 1,400 miles from the African coast and 1,700 miles from the nearest point of South America. This very remote island received its name from the Portuguese mariner Tristão da Cunha, who was the first man to look upon its 6,000 ft. volcanic mountain which rises, sheer and frowning, from the tumultuous ocean.

The history of the colonization of the island is interesting. When Napoleon was exiled to St. Helena, the British Government sent a detachment of Hottentot soldiers to guard the island against Napoleon's friends, who, it was rumoured, were to use it as a base from which to rescue him. The Hottentots left Tristan da Cunha after a year, but their Scottish corporal, William Glass, remained behind and was the founder of the present colony. To Tristan, in 1938, a Norse expedition, not without considerable difficulties, made its way, and the book under review, a translation from the Norwegian, gives an account of the scientific work carried through by the members of the expedition. The book is on the whole well translated, but here and there, in the naming of birds, difficulties occur. For example (p. 77) it is mentioned that "the small isles of the Tristan group are the only known breeding grounds of the petrel in the world". It is obvious that the translator has fallen into error here. It would seem probable that for "petrel" the translator should have written "great shearwater" (*Puffinus gravis*). This shearwater has a remarkable history. It has been shown in Murphy's "Oceanic Birds of South America", on the authority of Wynne-Edwards, that in the northern hemisphere spring the great shearwater leaves the South Atlantic, crosses the tropical oceanic zone with great swiftness, reaches Davis Strait by early June, and in August arrives at its most northerly limit, in Greenland waters. This is a vast flight to carry through each year, but there is reason to suppose that the great shearwater may nest at a longer interval of time than a single year, and that each bird may not return to its nesting islands in the Tristan group with each recurring season.

Although we are left in doubt as to the exact identity of the birds, there is a graphic account of the petrel's song (p. 72 *et seq.*):

"An immense flight was coming in from the sea that evening, first a few thousand which began the song accompanied by the birds which had remained at home and which now greeted the newcomers. But the song rose until tens of thousands were curvetting above our heads before the sun went down. In the twilight hundreds of thousands reached the island and their song rose to a roar.

"The concert reached its highest pitch before darkness set in. We had to admit that there really was a beautiful musical effect in these voices, which first seemed near when a solitary petrel flew low over the tent, delivering the whole verse so that we heard each word, and then far away, when the murmur of the hundreds of thousands blended into one song beneath the stars."

On p. 112 is an account of the small flightless bird known as Atlantisia which, we are told, lives only on Inaccessible Island of the Tristan group and has not before been described in a book. The small bird is nocturnal, and in its home in dense vegetation is most difficult to see, let alone capture. One could wish that the account of the first meeting with Atlantisia were more full.

"First of all only two fiery, deeply-set eyes were visible, then the light of my torch suddenly shone on so tiny and frail a creature that I felt I must be dreaming. Had I dared I would have pinched my arm. . . . I was reminded of a little photograph of a kiwi."

SETON GORDON.

Babes in the Darkling Wood

By H. G. Wells. Pp. 399. (London: Martin Secker and Warburg, Ltd., 1940.) 9*s*. 6*d*. net.

MR. H. G. WELLS has done much to raise the prestige of science among the people. Here, at the age of seventy-four, he is still trying, with the intensest energy, to communicate to the generality of mankind the implications of science. In his latest book he has used the technique of the novel of ideas to represent the attitude of young people to current events, and suggest what line they should pursue in the light of modern psychology. The ideas of Pavlov and Freud are discussed at length through the dialogues of the characters, but though an impression of their importance is conveyed successfully, they are not very clearly explained.

Mr. Wells recommends that the problem of modern life should be approached in the spirit of the sculptor who contemplates a block of uncarved marble. The possibilities in it should be conceived by a flexible imagination, and all should hack away at it until they have carved out the figure of society that they desire. The advantage of this approach is that it precludes doctrinaire planning. The sculptor is unable to make a finished preliminary draft of the three-dimensional end at which he aims, and must trust to the guidance of intelligent imagination in the course of his work. But this does not prevent him from having some drafts, and a model in his imagination which undergoes continual adaptation and is therefore living. Though Mr. Wells tends to become ever more discursive, his belief in the future and continual wrestlings with the present are still a major inspiration. J. G. CROWTHER.

Qualitative Organic Chemistry

By Neil Campbell. Pp. ix+213. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

THE isolation of pure organic compounds and the common criteria of purity are first discussed. An account of preliminary tests for classifying the unknown compound is then followed by details of more specialized confirmatory tests. Next, a review of the properties of various organic types is associated with information on the choice of derivatives suitable for the identification of specific members of each class. Practical methods for preparing thirty-two kinds of these derivatives are then given, this chapter in particular being provided with many references to the literature. A short note on the examination of mixtures concludes the first part (100 pp.) of the book. The second part (98 pp.) consists of a series of classified lists of various groups of organic compounds, with summaries of the properties of the individual substances and useful derivatives. A short bibliography and indexes are also included.

This is a thoroughly sound and up-to-date little book; besides acting as a handy and dependable *vade mecum* in the laboratory, it will stimulate its users to refer to standard works and original papers, and in general to turn to full account the educative value of this important field of practical organic chemistry. J. R.

L'Origine des cellules reproductrices et le problème de la lignée germinale

Par Prof. L. Bounoure. (Collection des actualités biologiques.) Pp. xii+272. (Paris: Gauthier-Villars, 1939.) 100 francs.

WHILE, perhaps particularly in Great Britain, most of the recent work on the reproductive cells has been concerned with the intimate structure of the chromosomes and their behaviour during fertilization and division, and with the consideration of certain extra-nuclear structures, Golgi bodies, etc., the questions of the history of the germ cells themselves and their relationship to the corresponding cells of their parents have continued to occupy the attention of zoologists. The time was ripe, therefore, for a review of these lines of research, and it has been provided by Prof. L. Bounoure, who is well known for a succession of papers in this field. Previous workers, including Jäger, who first used the expression "Continuität des Keimplasmas" in 1877 and not Weismann as is generally believed, had put forward speculative theories on the subject. The first to realize the problem definitely and to investigate it scientifically was M. Nussbaum in 1880. The present volume, after a historical introduction, reviews the whole subject of the origin of the germ cells and germinal continuity in an exhaustive manner throughout the animal kingdom. The account is fully documented by quotations of the crucial statements and contains discussions of the theoretical questions involved. It is a most useful and readable publication.

Special Surgery in Wartime

By D. W. C. Northfield, Dr. Douglas McAlpine, Dr. V. Zachary Cope, T. Holmes Sellors, A. B. Wallace. (*The Practitioner* Booklets.) Pp. vii+74. (London: Eyre and Spottiswoode (Publishers), Ltd., 1940.) 6*s*. net.

THIS little book provides a concise but comprehensive description of the most important types of war injury. Mr. D. W. C. Northfield has given an excellent clarification of the relations between the clinical picture and the underlying pathological changes in head injuries, and his summarization of the treatment is most helpful. Dr. Douglas McAlpine has surveyed spinal cord lesions well, but although he quotes Watson Jones, he has failed to emphasize the types of injury in which it is dangerous to reduce the deformity by manipulation and in which open reduction is necessary to prevent either the onset or progression of a paraplegia.

Mr. Zachary Cope and Mr. Holmes Sellors, on abdominal and chest injuries, should be read by all.

The treatment of burns at the moment is undergoing startling changes, and, although Mr. A. B. Wallace has written along the orthodox lines, his article will quite soon be out of date. For example, he still recommends tannic acid in the treatment of burns of the hands, and no mention is made of more modern methods of treating third degree burns by saline baths, irrigation in Bunyan-Stannard bags, etc.

Finally, a most useful appendix summarizes the uses of the sulphonamides in war surgery.

Starch and its Derivatives

By J. A. Radley. (Monographs on Applied Chemistry, Vol. 11.) Pp. x+346. (London: Chapman and Hall, Ltd., 1940.) 22*s.* net.

OF vital interest to the plant and animal physiologist and to the biochemist, starch has assumed a position of great importance also in applied chemistry and industry. To this latter domain this monograph properly belongs, and it is the latest of a series initiated by Dr. E. Howard Tripp with the intention of bringing together into one volume the mass of scattered literature, both old and new, which is of real value to the technologist in selected fields of chemical industry. This is a service which is widely acknowledged, and the present volume will be welcomed by many readers.

The subject of starch touches numerous and varied industries which are often exceedingly remote from one another; and the uses to which starch and its derivatives are put is some index of the very diversified character of the researches on this subject. The original literature is perhaps more voluminous than that of any other natural product. Those who have an interest in this field will therefore be grateful to the author for collecting into a single volume a body of knowledge on the manufacture and industrial applications of starch and the products derived from it.

Those sections devoted to dextrins and gums and to the general examination of starches, including their detection and chemical evaluation, are especially noteworthy, as are also the plates contributed by Mr. E. Young reproducing photomicrographs of starches of different origin.

The interests of the textile and paper industries, and the preparation of adhesives, receive more attention in this monograph than does the fermentation industry, which is a field too specialized for intensive treatment in a volume of this kind. A valuable and welcome feature is provided by the wealth of original references which are printed at the end of each chapter. It will be recognized that the merit of the different sections, treated so comprehensively, is a little unequal. That devoted to the structure of starch includes a review of some experimental data which have been superseded and could preferably have been excluded; and generally one wishes that the author's selection of material had been more critical.

A Handbook of Malaria Control

By R. Svensson. (Published by the Shell Group of Oil Companies.) Pp. viii+74+6 plates. (London: Ross Institute of Tropical Hygiene, n.d.) n.p.

THIS useful little book by an assistant director of the Ross Institute of Tropical Medicine is primarily intended for laymen, especially planters, engineers and others, who have to undertake anti-malarial work in the tropics, but it may also, as Sir Malcolm Watson remarks in the preface, be of use to medical practitioners. Within a small compass the book contains a generous quantity of valuable information, including not only an account of the different forms of malaria control but also a general survey of the malaria problem, notes on the various species of anophelines, laboratory equipment and methods, and a bibliography of recent British writers on the subject. The publication of the work has been undertaken by the Shell Group of Oil Companies.

Organic Syntheses

An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 20. Pp. v+113. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 10*s.* 6*d.* net.

SOME forty substances are handled in this volume, of which one (sodium amide) is inorganic. Preparations of open-chain compounds include those of acetylacetone (by the boron trifluoride and sodium ethoxide methods), fumaryl chloride, tertiary butyl acetate (using acetyl chloride in presence of dry ether and magnesium), and the methyl esters of myristic and palmitic acids from the wax of the bayberry (*Myrica cerifera*). Among substances of biochemical importance, preparative details are given for the *dl*-forms of cysteic acid, serine, threonine, and valine; moreover, glucose is used as the basis of penta-acetyl-*d*-gluconontrile, *d*-arabinose, and 2,3,4,6-tetramethyl-*d*-glucose. Some of the most interesting heterocyclic items are 1,2,3-benztriazole, dehydro-acetic acid, 5,5-dimethylhydantoin, 5-nitroindazole, and picolinic acid hydrochloride. A useful selection of aromatic substances includes terephthaldehyde (from *p*-xylene), 2,2′-dinitrobiphenyl (from *o*-chloronitrobenzene and copper bronze), diphenylketene (from benzil monohydrazone), monoperphthalic acid, and mandelamide (from the acetone condensation product of mandelic acid, by ammonolysis with liquid ammonia in Dewar flasks). From the fact that the index covers volume 20 only, we infer hopefully that Collective Volume II, including annual volumes 10 to 19, is now in course of preparation.

J. R.

Plant Physiology

By Meirion Thomas. Second edition. Pp. xii+596. (London: J. and A. Churchill, Ltd., 1940.) 21*s.*

THE first edition of this valuable text-book was reviewed in NATURE of June 20, 1936, p. 1012; we are pleased to know that the book was so well received as to make a reprinting necessary in 1937 and now a second edition appears.

The general arrangement of subject-matter remains unaltered, though, of course, certain recent advances in plant physiology have been incorporated in the new edition. The chief of these include respiration, oxidation enzymes, the zymase-complex, absorption of solutes, translocation and storage of solutes in the cotton plant, mineral nutrition, composition of chloroplasts, reactions in photosynthesis and plant hormones.

Although certain deletions have been made, about a hundred pages have been added to the text and the price has been increased from 14*s.* to 21*s.*

ENGINEERING PROGRESS AND THE SOCIAL ORDER*

BY DR. FRANK B. JEWETT AND DR. ROBERT W. KING
BELL TELEPHONE LABORATORIES

THE recognition is universal that a systematic investigation of Nature and a practical application of the resultant knowledge have placed new tools and new weapons of great potency in man's hands. The importance of science in shaping the daily course of events has been made known to all, partly through the literature of technology, but chiefly by the instrumentalities themselves and their omnipresence in our daily lives.

One of the incidental results of modern scientific research is that it has emphasized as never before the gulf which separates the remarkable powers and the equally remarkable shortcomings of the human mind. In the face of these shortcomings we must all have wished at times that they were not immutable, so that something might be done to improve the breed, as it were. Some people have an implicit, if not indeed an explicit, faith in the pliability or tractability of human nature, which leads them to believe that peoples as a whole can be raised morally and therefore be made less willing to engage in the type of conduct of which the world to-day displays too many illustrations. But our own experience—concededly limited—has forced us to the conclusion that human nature, in the aggregate and on the average, is about as unchangeable as any of the quantities and forces with which we have been surrounded and with which we have to deal. If there is any way out from the morass of conflict and doubt in which we now struggle, it would be our opinion that it must involve changes elsewhere than in the fundamental unit which man himself constitutes.

As a result of some two centuries of evolution, scientific method has become the most powerful intellectual tool in man's possession. It is based upon the principle of consciously controlling experimental conditions, to the end that only selected factors or parameters are allowed to vary simultaneously. Long success has demonstrated that such a method supplies the firmest foundation, not alone of exact measurement but even of meaningful measurement. Controlled experiment has brought to light prolifically the exact interrelationships manifested by natural forces. The procedure is one which eliminates all speculation and guesswork from the end-results of science, while still permitting ample play to these processes of thought in the exploratory operations which comprise the chief work of the man of science and engineer. Surrounded as we are with detailed supporting evidence, it is not necessary to emphasize that the experimental method as employed in modern science has met the most stringent pragmatic tests, and that only through it could the full measure of usefulness—and, conversely, of harm—which resides in the agencies of Nature have been made available with the rapidity which is now historic fact. While the logical and practical justification of the scientific method is so universally recognized in itself to call for no particular comment, the human mechanism which has evolved *pari passu* for the more effective carrying out of the method does provide much material for profitable reflection.

Immutability and irrevocability are fundamental characteristics of the facts of science, and facts once brought to light do not change, nor is it possible, once they are understood, to force them back into the limbo of the mysterious and the unknown. It would seem to follow that to the extent to which the evolution of science has demonstrated the need for certain types of human organization and human collaboration in order to be effectively conducted, these also might find a permanent, even an expanding part, in our daily affairs. In fact, it seems inevitable that through the evolution of the various sciences we will be led to create a new science—that of human organization. A considerable amount of empirical information is already at hand, but there is urgent need that it be expanded and made suitable for wider application. The recent course of events in the study and application of the exact sciences reveals what may well be a most significant trend, which of itself is innocent enough but when we come to envisage its counterpart in another field of activity, namely, that of military affairs, and on a much larger scale, forces us to the conclusion that a very difficult situation has already been created.

As science has expanded, carrying with it the range of human knowledge—an expansion which within a single century has reached fabulous proportions—the limitations of the individual mind have become more and more apparent. The pressure of these limitations has in turn expressed itself in the instigation of organized effort on the

* Substance of an address delivered on September 18, before the Section on Natural Sciences of the University of Pennsylvania Bicentennial Conference.

part of those engaged both in fundamental science and in its applications. More and more, due to his inherent limitations, the individual worker is being replaced by a carefully chosen corps, the various talents of which dovetail together and the collective knowledge and collective analytical powers of which greatly exceed those of any single member of the group. When working as a unit, the capabilities of such a group, measured by results, are likely to exceed by a considerable margin the sum of any individual achievements possible to its members. In essence it is the principle of the division of labour applied in the intellectual field, a principle that has long characterized that of manual labour.

It is in the field of the practical applications of science that the need of machinery for collaborative effort has been longest felt and most recognized. We surmise that this has in part been due to the fact that many of the problems which present themselves in the application of science are extremely complex, with respect to the detail they involve, and in part to the fact that a profit motive has added incentive to their accelerated solution. The chemical industries and electrical communication are among the outstanding examples that display the need and the possibilities of group attack.

It might be mentioned that the laboratory which functions within the Bell Telephone System comprises about 4,500 employees, one half of whom are skilled scientific workers and technicians, while the remainder include laboratory assistants and the necessary service groups of various sorts. Experience speaks so strongly that to-day no verbal argument is needed to justify the existence of such a centralized research and development organization.

But it becomes increasingly apparent every day that problems of so complex a nature as to demand organized attack are not peculiar to industry. Problems of this calibre are indeed becoming more and more the substratum of our daily lives and in increased proportion as we base our livelihoods upon the closely inter-related routines demanded by an industrialized society, and as we augment human effort at every turn with the facilities of the machine, as well as the involved chemical and physical processes which Nature has placed at our disposal. In the face of our growing involvement in the results of our own activity, our choice must either be to run the risk of temporizing, or to undertake purposively to improve our organizational forms with the aid of which we may entertain a reasonable hope of matching our analytical powers to our problems as they grow in intricacy.

Recent experience shows that these problems are by no means limited to the domestic range, and that frequently they will arise as a result of conflict between domestic and international relationships. Isolation in to-day's mechanized world is as unattainable as it would be impossible to extract the detonating force from an enemy's explosives or lifting power from the atmosphere that now supports his aeroplanes. Current events prove clearly enough that unless the peoples of the world can by universal agreement impose an artificial simplicity upon our social, economic and political problems, those groups and nations who are backward in the development of organizational techniques and who choose to try to cope with their problems by outgrown methods, must expect to suffer the unenviable consequences of inefficiency. Barring the ratification and enforcing of such artificial restrictions—and the possibility of so doing seems forlorn indeed—we must recognize that the urgent need is to adopt and exploit all modern fact-finding instrumentalities to their full capacity.

In support of such a programme we would urge that the method of the industrial laboratory is already proving productive when thus transplanted. We may now witness it in action on a nation-wide scale. Germany, under the Nazi regime, has become none other than a vast laboratory dedicated to the perfection, not of the arts of peace, but of the arts of war. It is not necessary to postulate any unusual skill at organization to explain the startling character of recent Nazi military achievements. The answer lies in the simple fact that the present German technique applies systematically and energetically to the affairs of a nation at war the precise methods which have characterized much industry for a generation or more. We frequently refer to it as German thoroughness. It does, of course, represent thoroughness—the kind of thoroughness which characterizes the well-managed industry with adequate research facilities. In the case of the Nazis, their organization includes virtually the entire home population plus their numerous agents abroad. We have the strongest possible proof that to wage a modern war successfully involves detailed co-operation between all a nation's population groups.

We are acquainted in general terms with the uniformity of control that the war effort exercises over every activity of German life. It is not a prospect which appeals to those of the liberal persuasion. But however much we rebel at the thought of complete submersion of our individual lives and privileges in a war-making machine, we must recognize that what we are witnessing is a battle between types of organization. In war the totalitarian State is proving itself a most potent adversary. It may, in fact, go farther than this and prove also to have great survival power following war, unless perchance experience ulti-

mately discloses that every branch of the human race without exception is so constituted as not to submit for long to the degree of dictation and regimentation that totalitarianism involves.

But for the moment we cannot safely assume that mankind will shortly, or even in the long run, display such uniformity of taste. All we know is that dictatorship has never long endured, but has always proved the prey of disruptive forces working either from within or from without, or both. However, we must not be guilty of an over-optimistic assumption at the present time, for it is being forcefully brought to our attention by current events that through science and engineering the essential paraphernalia of dictatorship are much more readily to hand than ever before and are much more effective.

Recognizing these manifestations of modern technology, it is abundantly clear that the peoples of the world are faced with the need of making certain momentous decisions, and making them quickly. No longer can we regard with indifference the effort needed to overthrow an established dictatorship, even after it has become utterly repugnant to its subjects. We face two very unpleasant potentialities in the fact that a small but well-organized and equipped minority can impose its will on a much larger majority. We have already seen this happen within national boundaries in the case of each of the totalitarian States. But what is more significant, we are now beholding such an entrenched minority extend its sphere of conquest to much larger circles beyond its own national boundaries.

The future consequences of these recent developments are not easy to gauge. It does seem essential, however, that we make a new accounting of political methods and instrumentalities to the end that we are enabled to select those best suited to the conditions imposed by present-day technology. Our inherited social techniques give evidence of having lost an important measure of contact with reality. In an ideal sense we may still applaud Franklin when he said, "They that give up liberty to obtain a little temporary safety deserve neither liberty nor safety." But the vital fact for us who live to-day and which has asserted itself since Franklin's time is that a minority who are willing to sacrifice their own liberty—or who perhaps have been so unlucky as unintentionally to sacrifice it—can compel a majority who cherish it to lose theirs. The only effective avenue of escape seems to be to find some way of preventing the minority from giving up their liberty. If this is not done only a Hobson's choice remains, so far as the majority is concerned. They may elect either to lose their liberty by being worsted in a struggle for which they are improperly prepared, or they may, by submitting in large measure to totalitarian methods, put themselves in condition to resist attack successfully. Hence, the mere existence in the world of a totalitarian State of any magnitude, when coupled with the threat of war which history shows is always inherent in the concentrated power of dictatorship, constitutes a death threat to all liberal forms of government. Now that mankind is in possession of the weapons made possible by modern technology, the planet has suddenly grown too small to support simultaneously the type of totalitarianism and the type which we associate with liberalism. To combat the Nazi 'total war', there is only one possibility—that of *total peace*.

The foregoing argument would only be strengthened were we to consider such additional factors as wage, price and profit controls. Here again the liberal State as it now operates is at a distinct disadvantage. The authority necessary to establish such controls is entirely repugnant to the democratic way of life, except in so far as they can be worked out by voluntary acquiescence on the part of the individual. Yet the energetic waging of war—and in fact the energetic waging of commercial war in times of nominal peace—must involve the equivalent of these authorities in the highly integrated modern industrial State and also in the world at large. In a word, unless the democracies and would-be democracies can dictate and control the rules of the international game of give-and-take, they are likely to prove but pawns in the hands of the totalitarian powers, *if any such there be.*

To us who have, as we have, witnessed the rise of modern technology and who have been intimately associated with the rapid development of technology, it seems transparently clear that we of the free nations must alter in a fundamental fashion our methods of solving social and political problems. We would urge upon those who would preserve liberalism that it must make available to itself the type of instrumentality which has been found so prolific of results in science and engineering, and which in Germany we see turned so effectively to the destructive operations of war.

As to whether the State founded upon dictatorial authority represents a continuing type, it seems only safe to assume that at least potentially it will remain a serious menace to all democracies. In the first place, it and the planned economy are essentially one and the same thing. It has frequently been pointed out that national planning, irrespective of the innocence with which it is launched or the beneficent ends held in view, will inevitably lead to dictatorship provided the political authority is created to enforce the plans when once they have been made. Time does not permit our retracing the argument to-day ; we will

say, however, that it appeals to us as having strong presumptive validity, and the conclusion immediately deducible therefrom is significant as regards our present discussion. The increased complexity of function which is being imparted to our social, industrial and political life by a growing technology, demands on one hand a wider variety of specialized training and skill, while on the other it calls for closer co-ordination between these specialized groups to the end that more rigidly guided and more narrowly confined spheres of action are imposed upon the individual, be he human or corporate. Such expanding specialization connotes planning, while the expanding need of guidance suggests dictatorship. We see, therefore, that the two conditions are likely to merge *unless* great care is exercised to hold them apart.

A great deal hinges upon that word 'unless'. What procedure is at once compatible with freedom of action on the part of the individual and yet with the need of circumscribing and directing his activities ? The field of choice cannot be a broad one. In fact, it seems to resolve itself into one single possibility, that of voluntary and educated guidance imposed by the individual himself, and therefore in turn by public opinion.

Whenever we make the attempt, dispassionately, to contrast the extremely casual, not to say misinformed, methods usually employed by representative Governments in transacting their public business, with the painstaking studies which underlie most operations of private business, we cannot but be amazed. It is probably safe to say that, as concerns the United States, our Federal Government frequently spends tens or even hundreds of millions of dollars after less examination of the merits and ultimate soundness of a scheme than a private corporation would put into the planning of a very minor mill or factory. The lack of any threat that the supply of public money would run short has, of course, permitted the continuance of such a casual policy long after it became apparent for other reasons that the operation of Government on the basis of popular whim and fancy and political self-interest could only end in absurdity, if not in disaster.

Suddenly the evidence has swelled to such a volume that we are perhaps in some danger of being confused and misled by its very bulk. As never before, it seems that liberally inclined peoples must put their faith in the more effective pursuit of knowledge and the possibility of popularly interpreting this knowledge once it is obtained. Quite obviously, this second point is as important as the first ; knowledge in possession of a few who are without authority is powerless, while knowledge in the possession of a few with power to employ it is totalitarianism. Understanding must be the possession of the people if they are to retain their sovereignty.

As to an agency to be employed in the more effective pursuit of the knowledge which efficient and effective public management presupposes, we have already intimated that the modern industrial laboratory offers an admirable starting-point. It is the function of such an institution to bring together in intimate association a considerable number of experts and technicians whose professional knowledge and skills, when merged in harmonious co-operation, possess a productive capacity of proved merit. In fact, it seems to hold the one and only key to such enigmas as baffle the world to-day. Blocked by Nature in any effort to add materially to human intellectual capacity in a sufficiently short space of time, the alternative is to resort to the development of an organizational device for achieving the same end —a process not inappropriately termed super-organic evolution.

Nor should we be discouraged by the very obvious fact that the methods of attack in regard to problems of State must in one fundamental respect differ from those employed in technology. As previously pointed out, the basis of the experimental method is deliberate control of the factors and parameters which enter into any problem. This is quite possible when dealing with the inanimate forces of Nature, but there will be scant opportunity for the employment of such arbitrariness when studying the questions set by her animate creations. This limitation assuredly makes the approach more difficult, but certainly does not rule out the attractiveness of the mass attack ; if anything, it makes it more imperative. By the same token we must not be discouraged by the observation that while the problems of technology are in considerable measure quantitative and therefore susceptible of being stated in concrete and uncontrovertible terms, the problems of government, in proportion as they are difficult, defy reduction to simple methods of measurement. Here again, as the challenge mounts, the need for organized study and analysis surely increases.

We come now to a process that would be common to the duties of all properly directed laboratory groups, namely, that of reducing their findings to terms suited to general consumption. One of the commonest charges against the man of science is that while he may be very successful in discovering new facts, he is likely to fail or be indifferent to the description of them in terms which the so-called popular audience can comprehend. Whether the fundamental scientist who is primarily engaged in charting unexplored territory is justified in more or less disregarding the charge—and we must all agree that

in large measure he does disregard it—the problem is one which the successful industrial laboratory cannot set aside. Its principal duty, in fact, is so to interpret its findings and conclusions that management, who while highly skilled in many essential ways is not likely to be skilled in scientific principles and terminologies, can make its decisions intelligently in so far as they ought to take the work of the laboratory into account.

It is obvious that in all matters relating to technical consideration the laboratory is, or ought to be, supreme. Its purpose is clearly not to attempt to carry out the whims of management; its duty and prerogative are to develop and urge new instrumentalities and to advise management in its technical capacities as to what projects may be embarked upon with reasonable assurances of technical success. In a very real sense, therefore, orders go from the laboratory up to management. Nevertheless, the duties and responsibilities of management remain clearly defined. In the last analysis, all decisions are within its province and are its proper function. Aside from the aspects of the business which the work of the laboratory does not touch, it is the duty of management to decide what products of research shall be introduced into circulation, and when, as well as what in general, the future projects of the laboratory shall be. Decisions such as these are clearly of vital importance to the welfare of any business, and a management that is well advised will earnestly solicit the full co-operation of the laboratory before pronouncing final judgment in the fields in which it possesses an informed opinion.

The analogy between the manner in which a modern corporation employs its laboratory and the manner in which an equally modern State might employ a similar investigative and advisory body, is surprisingly close. The only outstanding difference—and it is one which would not appear to be especially significant—is that in this hypothetical modern State the public is served by a corporation around whose board it occupies all the directors' seats, and the democratic tradition therefore prescribes that it shall select its own management. There need be no resulting confusion. This is precisely the allocation of powers and duties which is contemplated in the formula, "Government of the people, by the people and for the people". Whatever advisory and investigative bodies the management of the State—which is therefore Government—is authorized to create, the public as its own board of directors will be in possession of the findings of such bodies and, moreover, can demand that management properly employ them in its acts and policies.

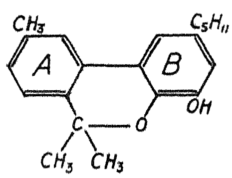
The purpose of this very brief discussion is to accomplish a twofold objective: first, to suggest that in the present confused state of world politics there is an acute need of the fullest understanding attainable; secondly, to point out that an instrumentality of demonstrated efficiency is available as a pattern. It is not our intention to venture any detailed suggestion as to the various organizational mechanisms which might be set up to accomplish the results which we envisage must be accomplished if the liberal form of government is to maintain its workability. At the same time we would not imply that the organizational mechanism to be created is anything short of being extremely difficult. Its solution will quite obviously call for a very high order of statesmanship and political invention. Certain models and experience are already available. As regards certain fields of science, routines are now in existence whereby an independent and highly competent group of experts may render advice to the Federal Government. These routines had their origin in problems arising during the Civil War, and with certain additions the routines have remained in effect. The group of experts who are on call as consultants are members of the National Academy of Sciences, or are such other experts as the Academy may choose to select. During 1917 the pressure of war work became such that need of closer advisory routines led to the creation of the National Research Council, a body subsidiary to the National Academy of Sciences and one which has remained in existence. Finally, as a result of the present crisis, the machinery of co-operation between the Federal Government and American men of science has been further enlarged by an Executive Order creating the National Defence Research Committee.

It is interesting that it has been war or the threat of war which has led to the creation and the elaboration of this machinery as well as to the periods of its extensive use. Our own view is that we are now well launched upon an era during which all of the existing advisory aids to the Government, as well as others still to be created, will have to function almost continuously. Thus, a prototype is already available, and when urgently needed enlargements are made, the Government, as well as the public which it serves, ought to be in a position to summon throughout the entire gamut of its civil activity the aid of the recognized experts of the nation. Such an arrangement need not savour of bureaucracy. But sovereign people will still remain sovereign. The belated and constructive recognition will be given to the fact, now abundantly clear to all, that the day is gone, and probably for ever, when a successful State can base its policies upon clamour of pressure groups or upon the uninformed beliefs of the majority, even though measured numerically by tens of millions.

CHEMISTRY OF THE HEMP DRUGS

By Prof. A. R. Todd
University of Manchester

THE resinous exudate from the female flowers of the hemp plant (*Cannabis sativa*) has for centuries formed the basis of a variety of narcotics known under a host of names (charas, hashish, ganja, etc.) according to locality and mode of preparation. The hemp drugs are eaten or smoked, the effects varying somewhat accordingly. Recently the smoking of hemp under the name of marihuana has attained particular prominence in America, where strenuous efforts are being made to combat its spread. Of all the common addiction drugs, least of a scientific nature is known about Cannabis, and this despite the fact that it has quite remarkable pharmacological properties. The isolation and characterization of the active principle or principles might well prove of considerable medical importance.



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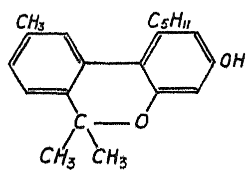

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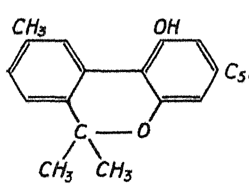

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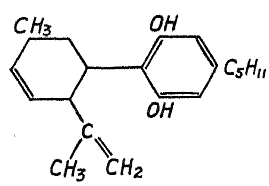

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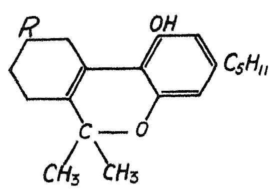

V

The reason for this lack of precise knowledge lies mainly in the intractable nature of hemp resin, although the difficulty of accurate biological assay and wide variations in the potency of various drug samples have in the past also contributed. The active constituent is contained in the high boiling portion of the resin, is nitrogen-free, and can be distilled in a high vacuum without decomposition. Much of the work done by earlier investigators was invalidated by their failure to realize that this distilled product, despite its fairly constant boiling point, is not homogeneous but contains a mixture of closely related substances. The first definite advance in the chemistry of the resin was made by Wood Spivey and Easterfield[1], who isolated from it, as a crystalline acetate, the compound cannabinol. Cannabinol is a cryptophenol of formula $C_{21}H_{26}O_2$, and it was investigated, later by Bergel[2] and Cahn[3]. The latter, in a series of elegant investigations, went far towards the elucidation of its structure; he was able to propose for cannabinol the structure (I) in which only the positions of the *n*-amyl and hydroxyl groups in ring *B* of the dibenzopyran system remained uncertain.

Following the work of Cahn, several years elapsed during which little chemical advance was made, although much valuable work on distribution and potency was carried out in various laboratories. The subject was reopened by Work, Bergel and Todd[4], who showed that cannabinol could readily be separated from Indian hemp resin (ganja) as a crystalline *p*-nitrobenzoate. They established, using the Gayer test[5] on rabbits, that cannabinol was not the pharmacologically active component of the resin, and effected a considerable concentration of the active cannabinol-free material by chromatographic analysis. They did not, however, claim homogeneity for their most active products. In subsequent work in my laboratory concentration by the same means has been carried to a point where the products give a positive Gayer test at a dose of 0·05 mgm./kgm. It was also observed that the so-called Beam test (red-violet colour with alcoholic potassium hydroxide) commonly used as a reaction for Cannabis extracts is not given either by cannabinol or by the active constituents of the drug[7].

Meanwhile independent investigations by Adams and his collaborators in America were in progress. These workers used as starting material the 'red oil' of Minnesota wild hemp; Todd and his collaborators, like earlier workers, carried out their investigations on prepared drugs of Indian and

Egyptian origin, which differ somewhat in composition from each other and from marihuana. From 'red oil' Adams, Hunt and Clark[6] isolated a new substance cannabidiol $C_{21}H_{30}O_2$ as its 3 : 5-dinitrobenzoate, the same substance being isolated very shortly thereafter by Jacob and Todd[7], from Egyptian hashish, where it was accompanied by cannabinol; the latter compound has also been recently obtained from American hemp[8]. Cannabidiol, which gives a strong Beam test, is pharmacologically inert and its structure has been largely elucidated in a series of papers by Adams and his co-workers, who consider it to be (IV)[13], although rigid proof of the position of one double bond is lacking. Simultaneously with the isolation of cannabidiol, Jacob and Todd[7a] reported the isolation from Indian hemp resin of a substance cannabol isomeric with cannabidiol. This substance, which gives no Beam test and has at most a trace of pharmacological action, was thought to be a partially reduced cannabinol.

The similarity in the empirical formulæ of cannabidiol and cannabinol together with their simultaneous occurrence suggest a close structural relationship, and since cannabidiol (IV) was early found to be a derivative of olivetol (5-*n*-amylresorcinol) the American workers concluded that cannabinol was probably represented by (II) or (III[9]). Meanwhile the observation that cannabinol gives a positive indophenol reaction, taken in conjunction with the earlier nitration results of Cahn, led Jacob and Todd[7b] to conclude that cannabinol could only be (I) or (III). The obvious deduction that cannabinol is represented by (III) was confirmed by the independent syntheses of cannabinol carried out by Adams, Baker and Wearn[10] and by Ghosh, Todd and Wilkinson[11].

None of the natural compounds, cannabinol, cannabidiol and cannabol, accounts for the narcotic properties of the hemp drugs. Recently, however, Haagen-Smit *et al.*[12], have reported the isolation from marihuana of a crystalline substance cannin, showing the typical activity of the drug in dogs. No details as to the nature of this substance are available, but the isolation is of great importance, and further work by these authors will be awaited with interest. Meanwhile, developments have occurred on the synthetic side which are of considerable moment. Adams and his collaborators[13] have observed that cannabidiol undergoes cyclization with acidic reagents yielding substances which have the composition of tetrahydrocannabinols and which show strong hashish activity; catalytic hydrogenation of these gives a hexahydrocannabinol which is also active though in lesser degree. Furthermore, 3′ : 4′ : 5′ : 6′-tetrahydrocannabinol (V; $R = CH_3$) first obtained as an intermediate in the cannabinol synthesis of Ghosh, Todd and Wilkinson[11], is also active both in dogs[13] and in rabbits[14]; the hexahydro-compound prepared from it has again a positive, if weaker, action. On the pharmacological side, collaboration is being maintained by the American workers with Dr. S. Loewe of Cornell University and by the British workers with Prof. A. D. Macdonald of the University of Manchester. Work on analogous synthetic products is being pursued, and although not yet widely extended it is clear that some structural variation is possible; thus, synthetic tetrahydro-*nor*-cannabinol (V; $R = H$) is also active in rabbits[14].

The fact that a variety of synthetic tetrahydrocannabinols show hashish activity lends colour to the view also expressed by Adams[13] that there may be several active constituents of this type in hemp resin, differing from each other in the position of the ethenoid linkage; cannin might well prove to be a substance of this type. Further support for this view is perhaps to be found in the fact that cannabinol-free active fractions of Indian resin have a composition corresponding to that of a compound $C_{21}H_{30}O_2$ containing one ethenoid linkage[15]. It may be mentioned finally that a consideration of the formulæ of the substances isolated from Cannabis resin suggests that they might arise in the plant by condensation of a terpene derivative with olivetol to give cannabidiol from which, by cyclization and dehydrogenation, cannabinol would be produced[7]. While such a scheme is hypothetical, evidence of its practicability in the laboratory is available, partly from the cyclization of cannabidiol to tetrahydrocannabinol, from which cannabinol can in turn be obtained[13], and partly from a new cannabinol synthesis recently carried out in my laboratory. In this synthesis pulegone is condensed directly with olivetol and the resulting pharmacologically active tetrahydrocannabinol subjected to dehydrogenation.

A number of other interesting points arising from the recent work on Cannabis must be omitted from discussion in this article. Much remains to be done before clarity is achieved; but the rate of progress during the past year has been such that one may expect a speedy solution of the outstanding problems.

[1] *J. Chem. Soc.*, **69**, 539 (1896); **75**, 20 (1899).
[2] *Annalen*, **432**, 55 (1930); **493**, 250 (1932).
[3] *J. Chem. Soc.*, 986 (1930); 630 (1931); 1342 (1932); 1400 (1933).
[4] *Biochem. J.*, **33**, 123 (1939).
[5] *Arch. Exp. Path. Pharm.*, **129**, 312 (1928).
[6] *J. Amer. Chem. Soc.*, **62**, 196 (1940).
[7] (*a*) NATURE, **145**, 350 (1940); (*b*) *J. Chem. Soc.*, 649 (1940).
[8] Adams, Pease and Clark, *J. Amer. Chem. Soc.*, **62**, 2194 (1940).
[9] *J. Amer. Chem. Soc.*, **62**, 2197 (1940).
[10] *J. Amer. Chem. Soc.*, **62**, 2204 (1940).
[11] *J. Chem. Soc.*, 1121 (1940).
[12] *Science*, **91**, 602 (1940).
[13] *J. Amer. Chem. Soc.*, **62**, 2402, 2566 (1940).
[14] Unpublished results of Prof. A. D. Macdonald.
[15] Bergel and Todd; unpublished observations.

OBITUARIES

Prof. E. W. MacBride, F.R.S.

BY the death of Prof. E. W. Macbride on November 17, within little more than a month of his seventy-fourth birthday, British zoology has lost a vivid and colourful personality and a distinguished worker. To the younger generation he was a member of a remarkable group of zoologists whose encyclopædic knowledge of the morphology of the animal kingdom was a matter of wonder and admiration. His outstanding record as a student shows clearly his capacity for hard work, and his later writings indicate how well he mastered and remembered his subject.

MacBride was born in Belfast on December 12, 1866. His undergraduate training was received at Queen's College, Belfast, and St. John's College, Cambridge, at the latter of which he was exhibitioner and foundation scholar. In 1889 he graduated as B.Sc. of London and two years later obtained his B.A. of Cambridge. Nor were his energies entirely devoted to science, for in his graduating year he was president of the Cambridge Union, an honour that reflects the esteem in which he was held by his fellow students.

After graduating, MacBride went to Naples, where he came under the influence of Anton Dohrn, then at the zenith of his career, and doubtless acquired his deep love for marine zoology. In 1892 he returned to Cambridge to become University demonstrator in animal morphology and in the following year became fellow of St. John's and was the first man to be awarded the Walsingham Medal for biological research. It was doubtless during these years that he laid the foundations of his wide knowledge of zoology, his eminence in which was recognized in 1905 by his election as a fellow of the Royal Society.

In 1897 he was appointed to the Strathcona chair of zoology in McGill University, Montreal, and in this city he met and married in 1902 a daughter of the late H. Chrysler, K.C., of Ottawa. He remained until 1909 at McGill and left a reputation for enthusiasm and energy which persisted for many years. In 1913 he was appointed professor of zoology in the Imperial College of Science and Technology in succession to Adam Sedgwick, and he remained there until he retired in 1934 and carried with him the well-deserved title of emeritus professor. Here he built up a well-known school of zoology that attracted workers from overseas as well as at home. During this time his eminence was recognized by the bestowal of the honorary doctorates of both McGill and Queen's Universities.

Apart from his strictly academic work, MacBride rendered valuable services to his country and to science by his work as chairman of the Council of the Marine Biological Association of the United Kingdom, the Advisory Committee of the Development Commission on Fishery Research and of the Bermuda Committee of the Royal Society. He also served on the Councils of the Royal Society and the Zoological Society, and the work of all these posts was carried out with the enthusiasm that was so characteristic of him.

His own research ranged over a wide field but his name became particularly associated with the Echinodermata, in the knowledge of which group he became an acknowledged master; and his most noteworthy general contribution to our knowledge of this group was the section on that phylum in the "Cambridge Natural History" volume published in 1906. This was and still remains about the most clear and useful account of the group available to English students. In 1914 he produced vol. 1 (Invertebrata) of the "Text-Book of Embryology" (Macmillan), in which he covered the embryology of the whole of the invertebrates and also the Protochordata in a lucid and comprehensive manner. Here his ability as a teacher is shown better than perhaps anywhere else, for, in spite of his deep knowledge of the Echinoderms, he allots to them no more space than could reasonably be expected, taking into account the relative importance of the phyla in a general scheme and what was then known of their embryology. Apart from the descriptions of the development of selected types of the different organisms, this volume also contains useful and illuminating statements, or discussions of various theoretical points, such, for example, as the biogenetic law, the interpretation of larval forms, etc. It is a definite contribution to the study of invertebrate embryology, not merely a compilation of information, and it needs to be taken into consideration by subsequent workers in this field. MacBride's critical ability also served him well in the selection, from the vast amount of material available, of just those facts that were required to provide a succinct and yet comprehensive review. In 1922 he contributed to the twelfth edition of the "Encyclopædia Britannica" well-known articles on cytology, embryology and eugenics. He also published a series of other works that have been widely read: "Introduction to the Study of Heredity", 1924; "Evolution", 1927; "Embryology", 1929; and "Huxley", 1934.

MacBride's keen mind was not satisfied with the mere accumulation of morphological knowledge, but constantly strove to deduce generalizations from the facts or to see how the current speculations accorded with them. This tendency became more marked in his later works, which, as their titles suggest, are concerned more with the theoretical aspects of biology. In the elaboration of a theory personal opinion plays a greater part than it does, or should do, in the compilation of morphological detail. Some of MacBride's conclusions did not conform with the commonly accepted, one might almost say orthodox, theories; but this did not deter him from putting them forward. He was, for example, generally regarded as the champion in Great Britain of Lamarckism or the heritability of acquired characters, although not in the crude form in which the idea was

originally proposed, and there can be little doubt that this was contrary to the main trend of current opinion. This statement requires some qualification. He did not suggest that all characters were acquired or that all acquired characters were transmitted; but, and this is an important distinction, he did suggest that there was evidence, experimental and other, to show that in certain instances changes induced by external forces in the parent could be handed on to the offspring even if in a modified form. As a corollary there is the possibility that the blind acceptance of the opposite point of view will lead to overlooking or misinterpreting evidence. That these opinions were honestly held no one doubted, and when they were put forward without rancour, with his wide knowledge and his cogency, even if they did not always convince, they certainly caused his opponents to pause and take stock of their position. Such jolts to the complacent acceptance of the orthodox are of considerable value. His ideas were by no means all heterodox, and by his clear exposition of both fact and theory he had considerable influence on contemporary zoological thought in Great Britain.

Although not a large man physically, one had only to be in MacBride's presence for a short while to realize that he had a dynamic personality and a well-stored mind. In meetings and in private discussions, no matter how widely the talk might range over the whole field of zoology, he had always a pertinent contribution to make. He has left a memory of untiring energy and remarkable knowledge, and those bodies and institutions that he served will also recall his loyalty and devotion so freely given.

There is another side to his life, although this is not the place to enlarge upon it. He was devoted to his family and in recent years settled down to a well-earned retirement in Alton, Hampshire. Here he had a delightful garden and was much interested in country life, in the affairs of his locality and in the parish church. To his widow we should like to extend our sincere sympathy.

Dr. F. L. Arnot

NEWS has been received from Sydney, Australia, of the sudden death early in October of Dr. Frederick Latham Arnot, for eight years lecturer in natural philosophy in the University of St. Andrews and, since 1939, lecturer in physics in the University of Sydney. He was born on September 29, 1904, at Sydney, of British parents, his father being Scottish and his mother English. He was educated in his home University, and after graduating with first-class honours in 1927, he was awarded an exhibition at Trinity College, Cambridge, and worked as a research student in the Cavendish Laboratory under the supervision of Sir Ernest Rutherford (later Lord Rutherford). Two years later he was awarded an Isaac Newton studentship, and received the degree of Ph.D. in June, 1930, for investigations concerning the collisions of slow electrons with molecules in gases at low pressures. His later results at Cambridge on the scattering of electrons in gases and on the diffraction of electrons in mercury vapour were of great beauty and importance.

In 1931, Arnot was appointed to a lectureship in the United College of the University of St. Andrews, and in association with his fellow-workers in the physical laboratory carried out valuable experimental work on ionization in gases and vapours. In these investigations new processes of ion formation were discovered, in particular Arnot's theory of negative ion formation at metal surfaces being of outstanding importance. The results obtained have important bearings on technical problems, and are of interest in connexion with the formation of negative ions in the outer regions of the earth's atmosphere.

In 1939, he was approved for the degree of Sc.D. by the University of Cambridge at an unusually early age. He was offered and accepted a lectureship in physics in the University of Sydney, and in July Dr. and Mrs. Arnot left St. Andrews for Australia. After his arrival he at once set about the organization of research work with the assistance of advanced students, and commenced investigations on nuclear physics and cosmic ray phenomena. Mention should also be made of the great interest which he took in problems of cosmology, and a preliminary account of his views, admittedly of a somewhat speculative character, was published in NATURE of June 25, 1938. His many friends in all parts of the world deeply regret the untimely close of a promising career.

H. S. ALLEN.

Prof. Julius Wagner-Jauregg

A BRIEF announcement of the death at the age of eighty-three of Prof. Julius Wagner, Ritter von Jauregg, the eminent Viennese medical man who introduced inoculation of malaria as a treatment for general paralysis, appears in the October 5 issue of the *Schweizerische Medizinische Wochenschrift*.

Like his predecessor Kraft-Ebing (see NATURE, August 10, p. 194), he was born at Wels in Upper Austria, on March 7, 1857. He received his medical education at the University of Vienna, where his chief teachers were Stricker, professor of general and experimental pathology, and Leidesdorf, professor of psychiatry. He qualified in 1880 and five years later became lecturer in neurology and psychiatry at his Alma Mater. During 1889–1893 he was extraordinary professor of neurology and psychiatry at Graz, and was then appointed professor in this subject at Vienna, where he remained until his retirement in 1928.

His early work was connected with the treatment of cretinism with thyroid extract, and of goitre with small doses of iodine. His most important achievement, for which he received a Nobel Prize in 1927, was the inoculation of benign tertian malaria for the treatment of general paralysis, which, though not devoid of risk, proved successful in about a third of all cases of this hitherto invariably fatal disease. The same treatment was afterwards applied in tabes. The method had been suggested to him by beneficial effects in various psychoses of pyretogenic substances,

such as staphylococcal vaccine or tuberculin. He also was the author of works on heredity, forensic psychiatry and the somatic pathogenesis of various psychoses. A bibliography of his publications up to 1928 was compiled by Prof. A. Pilaz (*Wien. Med. Woch.*, **78**, 842; 1928) and his portraits at different ages appeared earlier (*Wien. Med. Woch.*, **64**, 2239; 1914; *Deut. Med. Woch.*, **53**, 417; 1927).

J. D. Rolleston.

We regret to announce the following deaths:

Dr. J. W. Blagden, a director of Messrs. Howards and Sons, Ltd., formerly head of the research laboratories, aged sixty-seven.

Sir Harley H. Dalrymple-Hay, the well-known underground railway engineer, on December 17, aged seventy-nine.

Prof. Robert Emden, formerly professor of physics in the Technical High School, Munich, aged seventy-four.

Mr. E. H. Hayes, formerly mathematical tutor of New College, Oxford, on December 4, aged eighty-six.

Prof. Karl Hescheler, formerly professor of zoology in the University of Zurich, an authority on the osteology of prehistoric mammals, aged eighty-one.

Dr. A. B. Lewis, curator of Melanesian ethnology in the Field Museum, Chicago, on October 10, aged seventy-three years.

Prof. Alberto Pepere, professor of morbid anatomy in the University of Milan, aged sixty-seven.

Prof. H. J. Spooner, professor of mechanical and civil engineering in the Regent Street Polytechnic during 1882–1922, on December 16, aged eighty-four years.

The Rev. Canon Alfred Young, F.R.S., formerly lecturer in mathematics in Selwyn College, Cambridge, on December 19, aged sixty-seven.

Prof. Rudolf Zeller, formerly professor of geography in the University of Bern, aged seventy-one.

NEWS AND VIEWS

Peace Aims

One result of the proclamation of the Nazi "New Order" in Europe has been a widespread desire for a comparable statement from the British and Allied Governments of their intentions. A noteworthy contribution towards clarifying the situation has been made by a letter which appeared in *The Times* of December 21 over the signature of the Archbishop of Canterbury, Cardinal Hinsley, the Moderator of the Free Church Council and the Archbishop of York. Starting with the statement that no permanent peace in Europe is possible unless the principles of the Christian religion are made the basis of national policy and all social life, they base their letter on the five points put forward by Pope Pius XII a year ago. The first of these requires the "assurance to all nations of their right to life and independence"; violation of this equality of rights demands reparation, based, not upon force, but on the rules of justice and reciprocal equity. The second point refers to the need for "a mutually agreed organic progressive disarmament, spiritual as well as material, and security for the effective implementing of such an agreement"; and the third emphasizes the need for a juridicial institution to guarantee and, when necessary, to revise, such agreement. The fourth and fifth are less specific in that they ask for the adjustment of the needs of nations and populations and for the development of a sense of justice in accordance with the Christian ideal.

To these five points the signatories of the letter add five brief supplementary statements defining their attitude more precisely. They ask for the abolition of extreme inequalities in the distribution of wealth and possessions, for equal educational opportunity for all, and for the safeguarding of the family as the social unit. They also state that "The sense of a Divine vocation must be restored to man's daily work" and that world resources should be regarded as "God's gifts to the whole human race, and used with due consideration for the needs of the present and future generations". These simple and direct statements, coming from the leaders of the Christian Churches in Great Britain, will be received with general approval. Indeed, they crystallize the thoughts of many who have followed the present struggle, not with any doubts as to the righteousness of the British and Allied cause, but with anxious eyes for the future; and they may well form a useful substitute for an official Government pronouncement, hedged about as the latter would be by various provisos and qualifications. The letter will be accepted by all men of good will, whether associated with the Christian Churches or not, as an eloquent statement of war—and peace—aims of the British Commonwealth of Nations and her Allies.

Colonial Policy during and after the War

Lord Lloyd's statement on recent developments in colonial policy in reply to Lord Faringdon in the House of Lords on December 17 is of the greatest moment, not only as being in the nature of an interim report on the steps which have been taken to implement previous declarations of policy in colonial

affairs, but also as affording an indication of the line along which it is at present the aim of the allied powers responsible for colonial dependencies to direct future and post-war policy in inter-State relations. The British Government, earlier in the present year, pledged itself to a policy of colonial development so far as conditions might allow during the continuance of hostilities; while, in administration, liaison arrangements with the French Colonial Empire had already been brought into operation before the collapse of France. This co-operation between Colonial Governments, Lord Lloyd stated, has not only begun but is also being deepened every day during the War, and will be continued afterward when all the Colonial Governments will be free from the daily fear of Nazi aggression.

In support of this statement, Lord Lloyd was able to point to the important economic agreements which have been negotiated with the Free French colonies in Africa and with the Belgian Congo. Further, the British Colonial Office has organized within the office to continue the liaison arrangements with the French Colonial Empire. Recent developments in relations with the Dutch colonial authorities are even more striking. The British and Dutch Governments have been so strongly impressed by the results of joint discussion of problems common to Malaya and the Dutch East Indies, which have taken place both in England and between Sir Shenton Thomas and the Netherlands authorities in Batavia, that regular machinery has been set up to ensure that liaison in the form of a joint Anglo-Netherlands Committee on Economic Matters.

While these measures to promote a liaison in the important sphere of economics are a substantial beginning in the promotion of co-operation in administration between Colonial Powers, which will prove of the greatest value in planning post-War development in the Colonies under British administration, Lord Lloyd referred also to measures which, if less spectacular, should nevertheless have the practical result of assisting them in the initial stages of coping with the difficulties of the present situation. For the moment, action is directed in the main towards keeping up essential supplies in so far as is necessary to avoid war-time distress and to maintain the standard of living. Apart from special forms of assistance, financial and other, this has entailed urging upon the Colonies to grow more and better kinds of food, and in the relation of exports and imports to ensure that cash provided should be turned into essential supplies from outside. In this connexion Lord Lloyd pointed out that, in the past, the Colonies have concentrated too much on the production of some profitable export crop and have relied upon imports for their necessary foodstuffs. His predecessors, he added, for some years past had urged upon Colonial Governments the importance of mixed farming, by which the soil would be enriched and a better balance secured in agriculture. It is to be presumed that no opportunity in the future will be lost to stress the advantages of a policy for which the argument is now so greatly reinforced by the urge of necessity.

Dr. F. B. Jewett

THE resignation of Dr. Frank B. Jewett, president of the National Academy of Sciences, from his post as president of the Bell Telephone Laboratories, Inc., in New York City, has recently been announced. He now becomes chairman of the Board of Directors, and will thus have more time to aid the U.S. Government as a member of the National Defence Research Committee. He will be succeeded as president of the Laboratories by Dr. O. E. Buckley, who has been executive vice-president. For the past twenty-four years, Dr. Jewett has been the operating head of the Bell System's research programme, and since 1930 has been responsible both for the programme and its execution. He will now continue as vice-president of the American Telephone and Telegraph Company, in charge of research, as such retaining his jurisdiction over these activities. Dr. Buckley, new president of the Laboratories, has been associated with telephone research since he entered the Bell System in 1914. He became director of research in 1933 and executive vice-president in 1936 (see also p. 824 of this issue).

Jacob Petersen

DR. JACOB JULIUS PETERSEN, a well-known Danish medical historian, was born at Rönne in the island of Bornholm on December 29, 1840. He studied medicine at Copenhagen, where he qualified in 1865. After a visit to Germany, where he worked under Virchow and Traube in Berlin, he settled in Copenhagen. Besides his activities as a communal doctor he delivered lectures on the history of medicine from 1874 onwards, but it was not until 1887 that he received official recognition as a lecturer, and in 1890 was appointed extraordinary professor of medical history in the University of Copenhagen. His chief publications were on the contagion of tuberculosis (1869), chief factors in the historical development of medical treatment (1876), the older history of clinical medicine (1889), cholera epidemics with special reference to Denmark (1892), Danish medicine in the years 1700–1750 (1893), and smallpox and vaccination (1896). He died on May 28, 1912.

Museums and the Public

THERE is an aspect of museum work and museum service to the community of which little is heard and which nevertheless occupies a considerable part of the duties of the staff and is of some national importance. It concerns minor inquiries of many sorts which can be answered only by a specialist, and the answers to which may be of some value to the inquirers. Some of the miscellaneous economic problems placed before the Department of Botany in the Free Public Museums of Liverpool are instanced by H. Stansfield in an article in the *Museums Journal* (**40**, 215; 1940). A young woman was given a cigarette, collapsed on smoking half of it and remained unconscious for two days. The cigarette had been home-made by a man who used the leaves of a plant growing accidentally in his garden; the botanist identified the plant as Indian hemp, the

source of "hashish"; and the plant had grown from the refuse of a parrot's cage containing remains of a mixture from a chance packet of bird-seed. A point of insurance was decided by the relative inflammability of teff grass and ordinary hay. Questions of adulteration in manufactured chicory, inquiries about possible new sources of iodine, about diseases of bulbs, the qualities of timber for various specific purposes, the control of weeds, the identification of consignments of unrecognized materials, indicate the variety of information which is expected of a museum botanist.

Textile Studies at Leeds

REPORTS on the work of the session 1939–40 in the Departments of Textile Industries and of Colour Chemistry and Dyeing at the University of Leeds show that, although the number of students, particularly of those from overseas, has suffered to some extent and the time-table has had to undergo considerable alteration to meet the special conditions arising out of the War, the work of both Departments has been actively carried on and an impressive list of successes in the examinations of the University and of the City and Guilds of London Institute has been achieved. The degree of Ph.D. was conferred upon three students, one gained the M.Sc. degree and sixteen others graduated with honours. Twelve diplomas were awarded, while no fewer than forty-seven students obtained first class passes in the examinations of the City and Guilds of London Institute, several of them gaining prizes and silver medals. Facilities for work by the students in factories during the vacation, which forms a valuable and highly appreciated part of the training, have of necessity been somewhat restricted though not altogether suspended. In addition to the normal work of the research laboratories, much of which is carried out in co-operation with various firms in different parts of Great Britain, much attention is being devoted to problems of immediate national importance. Research activity has increased in intensity, not merely on account of the War, but also because of the appreciation shown by the industry in their results. A long list of recent publications in scientific journals is appended.

Forest Research Programme at Dehra Dun

THE triennial programme of work, 1940–42, of the Forest Research Institute, Dehra Dun, India (New Delhi: Government of India Press, 1940) gives evidence of the great progress made in this respect in India during the last three decades. When the Institute was inaugurated in 1906–7, the five branches still in force were decided upon, namely: sylvicultural, botanical, entomological, utilization and chemical. Some progressed more rapidly than others, notably utilization, as a result of the War of 1914–18 and the demands then made upon it. The present triennial programme shows, however, that advances in sound forest research have since made uniform progress in all the branches. The brochure is inevitably somewhat technical in many of the inquiries and research being undertaken, but in the sylvicultural branch investigations in various provinces are being carried on into that important subject in tropical forestry 'grazing combined with forestry'; also into erosion and soil-covering and its effects. The utilization branch has been for long subdivided into wood technology, timber testing, seasoning, wood preservation, paper pulp and wood workshop. Perhaps one of the surprising things about the Institute is that the minor forest products section, which is once again in 'cold storage', as it is expressed, owing to want of staff, has never received the serious attention which it so obviously seemed to demand. It would have been thought that from very early years in the functioning of the Institute, the Department and Government would have realized the enormous possibilities of research into the very large number of minor products of the Indian forests; lac and resin have already proved the value of experimental research work. It is difficult to understand this neglect.

Riveted Joints and Welded Joints

THE quarterly journal *Electric Welding*, issued by the Quasi-Arc Company, Ltd., Bilston, Staffs., is being discontinued. Advances which may occur in welded construction or technique will be published by distribution of technical circulars or by articles in technical or trade journals. The last issue of the journal (October) contains a paper by Prof. B. P. Haigh entitled "Riveted Joints and Welded Joints", who points out that riveted joints can be relied on to meet all ordinary requirements, provided that the working drawings of the structure provide the necessary scantlings. So firmly established is this faith in riveted joints that almost any failure in a riveted structure is attributed, if not to accident, then to faulty design of the structure as a whole. A riveted structure, if neglected, may be expected eventually to deteriorate by rusting. Water percolates between the plates and forms rust, forcing the plates apart between the rivets. The rivets become tighter for a time but eventually loosen or crack, and the structure falls asunder.

Welded structures may be expected to last longer in such circumstances because overlapping plates or rolled sections can be and commonly are very efficient from the mechanical point of view; thus channel sections welded back to back and welded all round the overlap, are so strongly joined that the rolled sections yield before the joints. The use of galvanized plates is not recommended either for riveting or welding, where full strength is required, particularly in vibration. At the high temperatures required for either riveting or welding, zinc is liable to penetrate between the grains in the steel, particularly when the metal is under tension, with the result that rivets and welds are then liable to crack in a brittle manner. When welds are made between galvanized plates of fair thickness, it is expedient to grind off the layer of zinc from the surfaces that will carry the fillets; but grinding is more difficult for riveted joints and is probably impracticable.

Electric Supply in East Africa

THE report of the annual meeting of the East African Power and Lighting Co. in Nairobi, at which Major Ward presided, is now available. Major Ward pointed out that in present circumstances it is not possible to give so much detail as in the past; but as the period since the outbreak of the War has passed with remarkably little change in the conditions in which the Company has been working, it has been able to maintain progress. Results in the East African Territories are largely affected by commodity prices, which were well maintained. The past year had shown considerable increase in the development of secondary industries. In 1939 the rainfall in the Nairobi area was the lowest on record, and the Company found much difficulty in meeting the demand of its consumers, but a supply was maintained until the rains broke. Actually there was a new 1,400 b.h.p. Diesel generator, due for delivery, but the War delayed shipment of the plant, which is the largest generator of this type in East Africa. It arrived in April last. Units sold in Kenya increased from nearly 14 million in 1938 to more than 16 million in 1939. In Tanganyika Territory, the Dar-es-Salaam and District Electric Supply Co. had an increased demand, requiring an additional plant capacity, and a further Diesel set was installed.

Health Conditions in Venezuela

IN a recent paper (*Bot. Ofic. San. Panamer.*, , 962; 1940) Dr. Julio García Alvarez, the Venezuelan Minister of Health and Social Assistance, remarks that the advance in public health in his country in 1939 includes the establishment of milk stations in 11 towns, of maternity hospitals in 10, the founding of a venereal disease dispensary-school, the completion of the Simon Bolivar tuberculosis sanatorium, the establishment of 40 centres by the Yellow Fever Service, and improvements in the national leprosariums and in the system of registering leprosy patients. In the campaign against malaria, 3,500 kgm. of quinine were distributed among 934 towns, and 312,985 treatments were given—two and a half times the number for the previous year. In 1939 the Ministry maintained 37 health units, a health commission, six health bureaux, 64 rural health officers and two port health officers, and its staff included 293 physicians, 14 sanitary engineers, 49 dentists, 43 laboratory workers, 244 inspectors, 294 nurses, 5 veterinarians and 1,237 unclassified employees as compared with 93, 2, 3, 26, 22, 54, 3 and 565 respectively in 1936.

The Night Sky in January

THE moon is full on January 13 at 11h. and new on January 27 at 11h. U.T. No star as bright as mag. 5·0 is occulted during the month. Jupiter and Saturn are in conjunction with the moon on January 7 at 7h. and 12h. respectively; Mars is in conjunction on January 23 and Venus on January 25. Jupiter and Saturn are near the southern meridian in the early evening. Saturn is stationary in its movement among the stars on January 10, after which the planet increases its right ascension very slowly. Jupiter's right ascension is increasing appreciably, thus bringing the two planets more closely together in the sky until the middle of February (conjunction on February 20 at 19h.). Jupiter's four inner satellites may be seen grouped most closely together at 20½h. on January 1, 4 (all eastwards), 11, 17 (all westwards), 19, 25 and 28. They will be seen widely grouped on January 8, 9, 13 and 31 (all westwards). Saturn's ring system is well presented for observation. Mars and Venus are both morning stars, the former predominantly bright in the morning skies before dawn. Clear evenings in January and February are associated with the brilliant assembly of stars attendant upon Orion. The Milky Way in this part of the sky is much fainter and less interesting than along its stretch visible during autumn evenings. During January, the night—sunset to sunrise—shortens by 1.2 hours in the latitude of London.

Announcements

DR. JEAN RAYNAL, director of the Pasteur Institute of Shanghai, has been awarded the French Commission Gold Medal in recognition of his work.

A CENTRAL institute for the investigation of foodstuffs is being erected at Utrecht to be in close association with the Institute of Hygiene.

THE second Pan-American Congress of Endocrinology will be held at Montevideo during March 5–8. 1941. Further information can be obtained from Dr. Pedro A. Barcia, Casilla de Correo 255, Montevideo,

COMPULSORY examination of students at the University of Budapest has shown that about 50 per cent are suffering from diseases such as nephritis, heart disease, tuberculosis, syphilis, etc., without knowing it.

IN 1934 the United States had only a little more than 5,000 cases of smallpox. Since then there has been a rapid increase. In 1937 there were 11,673 cases and in 1938 about 15,000. These figures indicate that, with the exception of India, smallpox is more prevalent in the United States than in any other country in the world.

THE Lac Research Laboratory of the London Shellac Research Bureau is removing from the Ramsay Laboratories, Chemical Engineering Department, University College, London. Inquiries should be sent to Mr. A. J. Gibson, India House, Aldwych, London, W.C. 2.

University of Birmingham: Air Raid Damage

INCENDIARY bombs have fallen on the buildings and in the grounds but the damage done was negligible. A part of the old building in the city which used to be the Department of Anatomy has been demolished.

The rooms of the Birmingham Natural History and Philosophical Society, which contained historic apparatus and a library of 8,500 volumes, have been totally destroyed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

An Enzyme from Bacteria able to Destroy Penicillin

FLEMING[1] noted that the growth of *B. coli* and a number of other bacteria belonging to the coli-typhoid group was not inhibited by penicillin. This observation has been confirmed. Further work has been done to find the cause of the resistance of these organisms to the action of penicillin.

An extract of *B. coli* was made by crushing a suspension of the organisms in the bacterial crushing mill of Booth and Green[2]. This extract was found to contain a substance destroying the growth-inhibiting property of penicillin. The destruction took place on incubating the penicillin preparation with the bacterial extract at 37°, or at room temperature for a longer time. The following is a typical experiment showing the penicillin-destroying effect of *B. coli* extracts. A solution of 1 mgm. penicillin in 0·8 c.c. of water was incubated with 0·2 c.c. of centrifuged and dialysed bacterial extract at 37° for 3 hours, in the presence of ether, and a control solution of penicillin of equal concentration was incubated without enzyme for the same time. (The penicillin used was extracted from cultures of *Penicillium notatum* by a method to be described in detail later. It possessed a degree of purity similar to that of the samples used in the chemotherapeutic experiments recorded in a preliminary report[3].) The growth-inhibiting activity of the solutions was then tested quantitatively on agar plates against *Staphylococcus aureus*. The penicillin solution incubated with the enzyme had entirely lost its growth-inhibiting activity, whereas the control solution had retained its full strength.

The conclusion that the active substance is an enzyme is drawn from the fact that it is destroyed by heating at 90° for 5 minutes and by incubation with papaïn activated with potassium cyanide at *p*H 6, and that it is non-dialysable through 'Cellophane' membranes. It can be precipitated by 2 volumes of alcohol, but much of its activity is lost during this operation. The activity of the enzyme, which we term penicillinase, is slight at *p*H 5, but increases considerably towards the alkaline range of *p*H. It is very active at *p*H 8 and 9. Higher *p*H's could not be tested as penicillin is unstable above *p*H 9.

The mechanism of the enzymatic inactivation of penicillin is being studied. No oxygen uptake occurs during the reaction, and the inactivation proceeds with equal facility under aerobic and anaerobic conditions. No appearance of acid groups could be detected by *p*H measurement with the hydrogen electrode. Extracts of a number of other micro-organisms, made by crushing the bacteria in the bacterial grinding mill, were tested for penicillinase. The enzyme was absent from extracts of the penicillin-sensitive *Staphylococcus aureus*, of yeast and of *Penicillium notatum*. It was present in a Gram-negative rod, insensitive to penicillin, found as a contaminant of some Penicillium cultures. Unlike *B. coli*, it was not necessary to crush the organism in the bacterial mill in order to obtain the enzyme from it; the latter appeared in the culture fluid. The enzyme was also found in *M. lysodeikticus*, an organism sensitive to the action of penicillin, though less so than *Staphylococcus aureus*. Thus, the presence or absence of the enzyme in a bacterium may not be the sole factor determining its insensitivity or sensitivity to penicillin.

The tissue extracts and tissue autolysates that have been tested were found to be without action on the growth-inhibiting power of penicillin. Prof. A. D. Gardner has found staphylococcal pus to be devoid of inhibiting action, but has demonstrated a slight inhibition by the pus from a case of *B. coli* cystitis. The bacteriostatic action of the sulphonamide drugs is known to be inhibited in the presence of tissue constituents and pus.[4] That the anti-bacterial activity of penicillin is not affected under these conditions gives this substance a definite advantage over the sulphonamide drugs from the chemotherapeutic point of view. The fact that a number of bacteria contain an enzyme acting on penicillin points to the possibility that this substance may have a function in their metabolism.

E. P. ABRAHAM.
E. CHAIN.

Sir William Dunn School of Pathology,
Oxford.
Dec. 5.

[1] Fleming, A., *Brit. J. Exp. Path.*, **10**, 226 (1929).
[2] Booth, V. H., and Green, D. E., *Biochem. J.*, **32**, 855 (1938).
[3] Chain, E., Florey, H. W., Gardner, A. D., Heatley, N. G., Jennings, M. A., Orr-Ewing, J., and Sanders, A. G., *Lancet*, 226 (1940).
[4] MacLeod, C., *J. Exp. Med.*, **72**, 217 (1940).

Morphological Effects of Penicillin on Bacteria

WHILE working with Chain, Florey and others on the inhibition of bacterial growth by penicillin[1], I noticed that concentrations of less than full inhibiting power caused a change in the appearance of the growth of *Cl. welchii* in fluid media. The normal uniform turbidity was replaced by a flocculent growth with a heavy deposit. Microscopical examination showed an extreme elongation of the majority of the cells, which took the form of unsegmented filaments ten or more times longer than the average normal cell.

I have now examined a number of bacteria grown in broth or serum broth with penicillin, and I have found similar microscopical changes in all the rod-shaped organisms that have shown any inhibition. These changes may be traceable, in the form of a distinct average lengthening of the cells, to a dilution eight or ten times, and even sometimes thirty times, higher than that which completely inhibits growth.

The Gram-negative rods, which are relatively resistant to penicillin, show the effect very well. Thus

in *S. typhi*, which was completely inhibited by a 1 in 1,000 concentration, almost completely by 1 in 2,000, and partially by 1 in 4,000, an elongation of the cells, which was enormous at these two latter dilutions, could still be detected at 1 in 32,000. *Vib. choleræ*, which was inhibited only slightly at 1 in 1,000, growing as immense swollen filaments, showed appreciable lengthening up to 1 in 8,000. Similarly with the Salmonella group, *Bact. coli* and other Gram-negative rods, which often showed grotesque giant-forms due to the autolytic swelling and frequent bursting of elongated cells.

The changes are similar to and at least as great as those figured by Ainley Walker and Murray[2] in their experiments on the effect of methyl-violet and other dyes on the typhoid-coli group of bacteria.

The growth of *Brucella melitensis* and *abortus* is not inhibited by penicillin at 1 in 1,000, the strongest solution tested ; nor is there any enlargement of the cells. But a vacuolation of the majority of them was seen in both species at 1 in a few thousands, and in *Br. abortus* this effect could be decreasingly traced right down to 1 in 300,000. It does not, however, seem likely that such a minor disturbance can be of great importance.

Gram-positive organisms, which are in general a good deal more sensitive to penicillin than the Gram-negative rods, show similar phenomena. For example, *Cl. welchii*, which was completely inhibited at 1 in 60,000, showed considerable filament-formation right up to 1 in a million and a half. In *Bac. anthracis* the corresponding figures were about 30,000 for total inhibition and 300,000 for lengthening.

With the Staphylococci the morphological change takes the form of spherical enlargement of the cell and imperfect fission, easily detectable at dilutions four to eight times higher than the completely inhibitory dilution, which, with a very small inoculum, may be as high as 1/800,000.

Streptococcus pyogenes, an extremely sensitive species, showed great swelling of the cells, incomplete fission with formation of large spinoles, and increased length of chains. This occurred at dilutions at least four times higher than the completely inhibiting dilution, which was 400,000. The growth was deposited, leaving a clear supernatant fluid. Several appearances were seen in *Str. viridans* at 1 in 50,000, though growth was completely inhibited at only 1 in 4,000.

I have not been able to see any morphological effect on the Meningococcus, though it is inhibited by penicillin at 1 in 50,000.

An observation by R. Tunnicliff[3] on the action of sulphanilamide on *Streptococcus viridans* probably points to a similar phenomenon. She found that the drug causes the coccus to form more and longer chains and to grow in granular form in fluid media. This change she considers to be in the direction of roughness, and adds that it "appears to make the Streptococci more phagocytable".

Thus it seems that toxic dyes, the atoxic penicillin and probably sulphanilamide cause similar morphological changes at incompletely inhibitory concentrations, and that the changes are mainly due to a failure of fission. Growth proceeds, but division and separation do not follow in due course. Many cells then fall victim to autolysis.

If the bacteria, as Tunnicliff suggests in the case of sulphanilamide, are thereby reduced in virulence, the chemotherapeutic agent can be expected to exert some action *in vivo* at concentrations much lower than those needed for complete inhibition of growth.

It should be noted that penicillin is not yet a pure substance, so that the figures given must be taken with considerable reserve.

A. D. GARDNER.
Sir William Dunn School of Pathology,
University of Oxford.
Dec. 10.

[1] *Lancet*, 226 (1940).
[2] *Brit. Med. J.*, **2**, 16 (1904).
[3] *J. Inf. Dis.*, **64**, 59 (1939).

Para-Amino Benzoic Acid as a Bacterial Growth Factor

THE mode of action of sulphanilamide has been the subject of much recent work. Possibly the most precise contribution has been Woods's discovery of the anti-sulphanilamide effect of *p*-amino benzoic acid ('p.a.b.'). In a discussion of this work, Fildes[1] has suggested that 'p.a.b.' might be considered an essential metabolite for bacteria. It is now inferred that sulphanilamide inactivates an essential co-enzymic grouping of the susceptible organism[1,2], and in view of Woods's work, this grouping is most probably 'p.a.b.'. Before this hypothesis of sulphanilamide action can be widely accepted it remains to be proved that 'p.a.b.' is essential for the growth of organisms inhibited by the drug.

Previous work by Brown *et al.*[4] on the growth requirements of the butyl alcohol - acetone organism, *Clostridium acetobutylicum*, has shown that thiamin, riboflavin, tryptophane, nicotinic acid, pimelic acid, pantothenic acid, alanine and uracil, are unable to stimulate growth in synthetic media. More recently Weizmann[5] (1939) has stated that biotin was essential for the growth of this organism.

In our earlier work on the isolation of the growth factor for *Cl. acetobutylicum* a yeast concentrate was prepared which supported growth of the organisms in a concentration of 2×10^3 μgm. per ml. of a basal medium of the following composition : asparagine 0·1 per cent, glucose 2·0 per cent, KH_2PO_4 0·5 per cent, K_2HPO_4 0·5 per cent, $MgSO_4$ 0·2 per cent, NaCl 0·1 per cent, $FeSO_4 . 7H_2O$ 0·01 per cent, $MnSO_4 . 4H_2O$ 0·01 per cent, in distilled water.

Thirty kgm. of brewer's yeast (wet) yielded 750 mgm. of yeast concentrate by a procedure too lengthy to describe in this communication. An ether extract of this concentrate was evaporated, benzoylated, and the product (recrystallized five times from alcohol), was identified as *p*-benzoyl-amino benzoic acid, m.p. 277° C., yield 2 mgm. In Table 1 are recorded the results of experiments condensed from the study of nine species of *Cl. acetobutylicum*, of which seven were isolated in this laboratory and two were obtained from the American Type Cultures Collection Nos. 862 and 4259. Growth has only been recorded as positive when the test medium gave growth in five successive subcultures.

From Table 1 the following conclusions may be drawn :

(1) *p*-amino benzoic acid and its derivatives act as growth factors for *Cl. acetobutylicum*.

(2) *p*-amino benzoic acid can be recovered from a yeast concentrate factor as the benzoyl derivative.

(3) Removal of *p*-amino benzoic acid from the yeast concentrate removes its growth factor activity.

TABLE 1.

GROWTH FACTORS FOR *Cl. acetobutylicum* AND RELATED SUBSTANCES.

Substance	Amount of substance per ml. of basal synthetic medium					
	2×10^{-5} μ gm.	2×10^{-4} μ gm.	2×10^{-3} μ gm.	2×10^{-2} μ gm.	2×10^{-1} μ gm.	2 μ gm.
1. Yeast concentrate			+	+	+	+
2. Yeast concentrate (after ether extraction)		−		−	−	−
3. *p*-benzoyl amino benzoic acid (from yeast concentrate)	−	+	+	+	+	−
4. *p*-amino benzoic acid	+	+	+	+	+	−
5. *m*-amino benzoic acid		−	−	−	−	+
6. *o*-amino benzoic acid	−	−	−	−	−	+
7. Novocaine	−	+	+	+	+	−
8. Sulphanilamide	−	−	−	−	−	−

Growth +, no growth −

A comparison of these results with the anti-sulphanilamide tests of Woods reveals a remarkable correlation. In this work the growth factor activity is: *p*-amino benzoic acid $6 \cdot 8 \times 10^{-8}$ *M.*, novocaine $1 \cdot 2 \times 10^{-8}$ *M.*, *ortho* and *meta* amino benzoic acid probably inactive. In regard to Weizmann's statement, it is presumed that his biotin, which stimulated growth, contained *p*-amino benzoic acid.

The bacteriostatic action of sulphanilamide on growth was determined by subculturing the organisms in the basal medium containing varying quantities of 'p.a.b.' and constant amounts of sulphanilamide. The results recorded in Table 2 confirm Woods's findings[6] on the anti-sulphanilamide action of 'p.a.b.' They also illustrate how it is possible to titrate the two antagonists using growth as the end point.

TABLE 2.

TITRATION OF *p*-AMINO BENZOIC ACID AGAINST SULPHANILAMIDE.

Concentration of sulphanilamide	Amount of *p*-amino benzoic acid per ml. of basal medium					Molecular ratio 'p.a.b.': sulphanilamide
	5×10^{-3} μ gm.	1×10^{-3} μ gm.	2×10^{-3} μ gm.	3×10^{-3} μ gm.	4×10^{-3} μ gm.	
$\frac{M}{1,650}$	−	−	−	−	−	23,000
$\frac{M}{3,300}$	−	−	+	+	+	23,000
$\frac{M}{6,600}$	−	+	+	+	+	23,000

Growth +, no growth −.

On the basis of the above figures one molecule of 'p.a.b.' antagonizes 23,000 molecules of sulphanilamide. This tremendous disproportion between these two antagonistic reagents makes it difficult to conceive how the growth activator 'p.a.b.' can overcome the effect of the growth inhibitor (sulphanilamide) if the two molecules are destined towards the same receptor site on the organism. The chances of the activator making first contact seem fairly remote when considered from a physico-chemical point of view.

SYDNEY D. RUBBO.
J. M. GILLESPIE.
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Oct. 22.

[1] Fildes, *Lancet*, **1**, 955 (1940).
[2] Stamp, *Lancet*, **11**, 10 (1939).
[3] Green, *Brit. J. Exp. Path.*, **21**, 38 (1940).
[4] Brown, Wood and Werkman, *J. Bact.*, **38**, 631 (1939).
[5] Weizmann, *Biochem. J.*, **33**, 1376 (1939).
[6] Woods, *Brit. J. Exp. Path.*, **21**, 74 (1940).

Chromosome Diminution in a Plant

THE genus Sorghum consists of two groups. Eu-Sorghum includes the tetraploid millet species and an octoploid fodder species[1]. Para-Sorghum includes only diploid species ($n = 5$) which are not cultivated. One of these is *S. purpureo-sericeum*, from the Sudan, in which I have described plants with varying numbers of extra chromosomes. These chromosomes I supposed to be inert[2].

I now find from meiosis in the pollen mother cell that, amongst a wild 1931 collection of seeds given me by Mr. C. E. Hubbard of Kew, 40 out of 100 had these extra chromosomes (Table 1).

TABLE 1.

PLANTS WITH *B* CHROMOSOMES IN *Sorghum purpureo-sericeum*.

No. of *B*'s	0	1	2	3	4	5	6	Total
Total plants	60	12	20	5	1	1	1	100
Tested in roots	—	8	7	2	1	1	1	20

Thus there appears to be the same kind of distribution of extra *B* chromosomes in the natural population of this species as occurs in certain cultivated varieties of maize[3]. Again as in maize, these *B* chromosomes do not pair at meiosis with the five ordinary members of the complement. They have, therefore, lost all effective relationship with the active chromosomes, alongside which they must have maintained a separate existence for a great time.

That these chromosomes are in some respects active, and disadvantageously active, is shown by the proportion of healthy pollen (from 500 grains each) in plants having different numbers of *B*'s (Table 2). Their long maintenance in the species therefore demands that they have certain compensating advantages for the plant.

TABLE 2.

EFFECT OF *B*'S ON AVERAGE POLLEN FERTILITY.

No. of *B*'s	0	1	2	3
No. of Plants	6	3	5	2
Good pollen	93·6%	83·6%	63%	11·5%

From mitosis in the root-tips, however, a new and remarkable property of these *B* chromosomes appears. Twenty plants having *B*'s in the pollen mother cells were examined. None had *B*'s in the roots. All had the ordinary chromosome complement of 10 (second line, Table 1).

Re-examination of the flower-tissues of these plants showed the presence of *B*'s at metaphase of mitosis. The resting cells also frequently contained small extra nuclei, which had doubtless arisen from lagging *B*'s. Since these chromosomes are maintained in the tissue, it seems that the extra nuclei must rejoin their companions during mitosis in the flower parts. In the early growth of the roots, on the other hand, they must be lost.

Now irregularities (attributed to a deficient centromere) have often been found in the mitotic movements of extra chromosomes, but never before has a regular loss of such chromosomes been recorded in a particular tissue of a plant. The case at once recalls the well-known *diminution* of chromosomes in Ascaris and, still more forcibly, the exclusion of certain 'sex-limited' chromosomes from the somatic line in Sciara[4].

The further study of these highly controlled chromosomes is therefore likely to throw light on

the physiology and mechanics of the more elaborate and more abstruse systems of chromosome diminution found in animals.

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Nov. 26.

[1] Hunter, A. W. S., *Canad. J. Res.*, **11**, 213–241 (1934).
[2] Janaki-Ammal, E. K., *Curr. Sci.*, (1939).
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Compression of Cylinders of Soft Materials

SOME time ago, we proposed an equation[1] to describe the behaviour of soft bodies under compression, with special reference to the compression of cylinders. Whereas for a true fluid we have $\eta = s\sigma^{-1} t^1$, and for an elastic solid $n = s\sigma^{-1} t^0$; we proposed for 'intermediate' materials

$$\psi = s\sigma^{-1} t^k$$

where s is shearing stress, σ is shearing strain calculated by the logarithmic formula, t is time of compression, η is viscosity, n is shear modulus, and ψ was described as the "firmness" and k as "a measure of elasticity", though we should no longer care to use the latter expression, since such properties as work-hardening and dilatancy would reduce k without increasing the elastic recovery.

This equation obviates the difficulties, both practical and theoretical, involved in attempting to divide σ into two parts, recoverable and non-recoverable, in order to calculate η and n for such materials.

In a later paper[2], psychological experiments were described which we believe to justify the use of ψ as a criterion of firmness, in spite of, or rather because of, its peculiar physical dimensions. In neither paper was it possible to give any data to test the equation, nor was it claimed that ψ and k would be expected to be constants for all materials independent of stress and strain conditions. It was, however, hoped that the new treatment would prove simpler than the classical analysis, in which very complex variations in η and n with varying stress and strain conditions and histories are to be found[3].

A direct test of the equation has now been made possible as a result of the design and construction by Dr. P. White and Mr. J. Cotton of an apparatus, to be described shortly, in which cylinders can be loaded in such a way that the load increases proportionally to the change in cross-section of the cylinder, the value of s thus remaining constant throughout the compression.

Under these conditions, the equation may be written :

$$\log \psi = k \log t - \log \sigma + \text{const.};$$

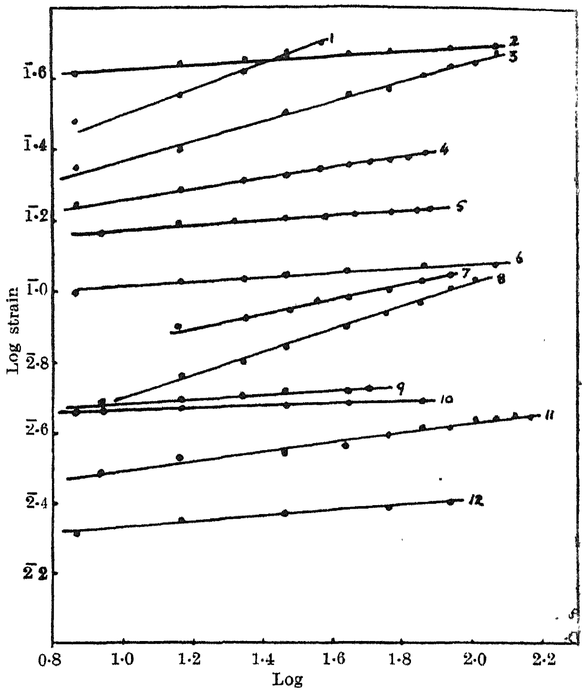
or, in the case where the log σ/log t curves are linear :

$$\log \psi = k - \log \sigma_{10} + \text{const.},$$

where σ_{10} is the strain produced in 10 sec.

In view of the principle underlying Fechner's law, it seems not unlikely that 'firmness' as judged subjectively may be related directly to log ψ, and for this reason as well as because the logarithmic values are easier to handle, we prefer to keep the data in the logarithmic form.

The new instrument was designed for experiments with cheese and butter, so that the stress range available is somewhat limited, but it has been possible



No.	Material	Radius	Shearing stress	Log ψ	k
1.	Worked butter	1·5 cm.	58,260 dyne cm.$^{-2}$	5·61	0·35
2.	Wet clay soil	1·0	131,100	5·53	0·035
3.	Rested butter	1·5	58,260	5·67	0·28
4.	Cake	1·0	102,500	5·89	0·14
5.	Acrylic acid polymer	1·0	192,600	6·18	0·06
6.	Mod. wet clay soil	1·0	131,100	6·17	0·055
7.	Cheddar cheese	1·0	131,100	6·47	0·20
8.	Stale bread	1·5	58,260	6·40	0·325
9.	Apple (flesh)	1·0	192,600	6·66	0·055
10.	Potato	1·0	192,600	6·66	0·035
11.	Plasticine-rubber Vaseline mixture	1·0	192,600	6·93	0·14
12.	Dry clay soil	1·0	131,100	6·86	0·07

to test, at a constant temperature of 60° F., a number of very varied materials, curves for some of which are shown in the accompanying graph. The log σ/log t curves are remarkably linear, except perhaps at very small strains, where measurements are, in any event, decidedly inaccurate.

Experiments with cylinders of Californian bitumen, which approximates very closely to truly fluid behaviour, indicate that the instrument is compensating correctly for the change in cross-section, unless exceptionally small loads are used. The only case where this error is likely to be just significant is for No. 4, but the curve is shown because of its intrinsic interest.

Our views as to the significance of k have altered in the light of experience with the apparatus. This will be discussed when the experiments are described more fully elsewhere.

G. W. SCOTT BLAIR.
F. M. VALDA COPPEN.
National Institute for Research in Dairying,
University of Reading. Nov. 25.

[1] Scott Blair, G. W., and Coppen, F. M. V., *Proc. Roy. Soc.*, B, **128**, 109 (1939).
[2] Scott Blair, G. W., and Coppen, F. M. V., *Brit. J. Psychol.*, **31**, 61 (1940).
[3] Schofield, R. K., and Scott Blair, G. W., *Proc. Roy. Soc.*, A, **138**, 707, (1932); **139**, 557 (1933); **141**, 72 (1933); **160**, 87 (1937.)

AN IRON AGE SETTLEMENT IN SOUTHERN BRITAIN*

THE aim of the excavation of the site of Little Woodbury, Wilts, was to uncover the settlement systematically and discover as much about it as possible as a social and economic organism. Little Woodbury being typical, its excavation throws light upon a number of similar sites. Excavations were carried out in the periods June 12–September 18, 1938, and June 12–July 19, 1939. Examination of the site has not yet been completed, but further work has been interrupted by the War.

The settlement lies 1½ miles west-south-west of Salisbury Cathedral, on low hills between the Avon and Ebble at about 270 ft. above sea-level. It is situated in a kind of plain of which the highest point is the middle of the site. Four hundred metres to the west is the larger settlement, to which the name of Woodbury has been given. In 1938, 4,500 sq. metres of the site were uncovered, and in 1939 a further 2,500 sq. metres. The traces of prehistoric occupation all belong to Iron Age *A2–AB*, which is regarded as extending over the period from the beginning of the third century B.C. into the first century B.C. The traces of occupation consist of ditches, pits, hollows, and post holes. Finds are few in number, suggesting that the settlers were not numerous, but the nature of the finds shows that the settlement was thoroughly agricultural in character, although the animals' bones indicate that the settlers carried on cattle rearing. There is no sign of industrial activity beyond what was necessary to supply the individual need of each, as for example in weaving. Slag points to the visits of wandering smiths. There is no evidence of any wealth of imported goods.

From the traces of occupation in the form of ditches, pits, hollows, and post holes, of which the examination is described in detail, certain inferences can be drawn. In the area enclosed by the ditches, about a hundred pits have been uncovered up to the present. They vary very much from one to another in form, and some clearly being later than others, obviously were not all in use at one time. In depth they range from 0·49 metres to 2·98 metres. After they had been in use for a time, the pits were filled in, the filling including fragments of chalk, burnt and unburnt flint, ash, potsherds, bones, food refuse, saddle querns and sandstone grinders, iron-slag, smaller objects of everyday use, and cob fragments which had been parts of ovens. From the uses of analogous subterranean receptacles elsewhere and at other times, it is inferred that these pits were used as granaries for the storage of corn, probably roasted previously. The shallower pits may have served to receive receptacles in which water had been stored.

Eleven isolated hollows, in form an irregular quadrangle, with steep or sloping edges and a level floor, were found within the enclosure. In depth they never exceeded a metre, while in size they varied from 10 m. to 24 m. They are dug out on a uniform principle. They were not used for dwelling places, and probably served some purpose in connexion with the harvest, just as in Upper Egypt to-day the women of the villages sit in similar pits to prepare the fruits of the harvest for storage.

The post holes indicate the ground plan of two houses, of which one, the farmstead, shows evidence of reconstruction, and probably represents an advanced stage of development of a primitive prototype in which a circle of huts with lean-to roofs served individual functions belonging to the farmstead. Other post holes, it is inferred, served as drying frames or racks, square granaries, and storehouses.

Each of these elements of the settlement existed over a long period (200–300 years); but while some such pits and work places were short-lived, others, like the houses, were long-lived. No large number of houses existed at the same time. Consequently, the settlement was not a village. Probably there was no more than one dwelling-house at any one time. It follows that this was a farm, with auxiliary buildings necessary for farm work, in which habitation was continuous. No water supply was near, and dependance on water collected from the roof makes it probable that no more than one family occupied the house.

The water deficiency also points to husbandry, rather than cattle farming, as the staple occupation. The open situation of the farm points to peaceful conditions at the time of its erection. The narrow entrance to the palisade precludes the use of carts or the quick driving in of large stocks of cattle, while the decorative gate-building has no military value. Later, however, there was sudden interruption to this state of peace, and it was necessary to provide powerful defences for the farm. The work was never completed, and the palisade again became adequate.

The excavation at Little Woodbury has thrown a flood of light on a large number of other settlements of the same age previously excavated. It is one of a series of farm settlements, not previously recognized as such, which all suffered the same fate and generally enjoyed a uniform civilization. It is calculated that round about twenty acres would represent the land requirements of such a farm, and it is no matter for wonder that these farms should be found lying comparatively close together.

In Woodbury one type only of Iron Age settlement has been established; but its existence presupposes other types. The settlements of the builders of the hill-forts have not yet been determined. Yet the erection of the hill-forts implies a strongly organized and relatively numerous community. Manifestly the people of the farms were too few to have been responsible for them. Their settlements must be sought on the lower slopes in proximity to water to serve both themselves and the relatively large stocks of cattle for which presumably such spacious hill-forts were erected.

All Cannings Cross, Wilts, seems to have been a village on a slope, a situation unusual for this part of the country. Though little of the settlement has been excavated, it is evidently considerably more extensive than the farm. Its inhabitants lived primarily by husbandry.

* *Proc. Prehist. Soc.*, N.S. **6**, 1 (1940). Excavation at Little Woodbury, Wilts.: The Settlement as Revealed by Excavation. By Gerhard Bersu.

The Iron Age $A2$–AB hill forts which were completed when excavated reveal the same civilization as the folk who inhabited other settlements marked by pits. The pits, however, are far too few to suggest that such hill-forts were either constantly inhabited *oppida* or concerned with urban civilization and industry. They were only built and inhabited for a short time during periods of unrest. On the other hand, both boundary ditches and hill-forts lead us to presuppose a substantial agricultural population living outside the farms in open settlements on low ground and on slopes close to water. In such settlements lived the greater part of the agricultural Iron Age $A2$–AB population.

ELECTRIC TUNNEL KILNS FOR FIRING PORCELAIN

IN *Electrotechnics*, the journal of the Electrical Engineering Society of the Indian Institute of Science, Bangalore (S. India), of September, there is published an instructive paper by H. N. Ramachandra Rao, of the Government Porcelain Factory, Bangalore, discussing the use of an electric tunnel kiln for firing porcelain.

Until recently, the discontinuous coal-fired kiln, known as the round kiln, was generally used for firing hard porcelain. This type of kiln has certain inherent defects and demands great skill in handling. The coal used for such a kiln should have a high calorific value and must be free from impurities.

In using these round kilns, the ware is kept in saggars (refractory containers) which prevent the ware from direct contact with the flames, provide for economic filling and keep the ware free from strain. To obtain the maximum temperature of 1,350° C. takes about 36 hours and the kiln has to cool for an additional 48–60 hours before being unloaded.

An important factor that enters into the correct firing of porcelain is the composition of the flue gases. In the round kiln it is very difficult to control the composition of the gases within desired limits on account of the unavoidable contamination or oxidation which takes place owing to the leakage of air into the kiln through combustion devices and holes or cracks that develop in a structure made of brick and fireclay when subjected to repeated heating and cooling. Besides, it is practically impossible to get a uniform distribution of heat inside this type of kiln.

The thermal efficiency of the kiln is very low, about 5–10 per cent, chiefly due to the wastage of heat from the hot gases, which are allowed to escape to the atmosphere at a high temperature. The working cost of such a kiln is again influenced by high labour charges, total holding capacity of the building and high cost of saggars.

These difficulties were to a great extent overcome by the introduction of fuel-fired tunnel kilns which are in more general use at present. There are two types of tunnel-kilns which are suitable for firing hard porcelain. In one type the products of combustion mingle with the ware; the most modern example is the Harrop kiln. The other is of muffled type, and is known as the Dressler kiln. The fuels in general use are natural gas or oil, and they are introduced with a small amount of air through highly refractory burner tubes. The tunnel is provided with a series of fire-places or gas burners on both sides and the goods to be fired are made to enter it on a chain of cars. The hot gases pass along the tunnel towards the end at which the goods enter, so that the ware is gradually heated as it passes towards the hottest part of the kiln. After having attained the maximum temperature required the ware travels on through the remainder of the tunnel, meeting in the journey a current of air travelling in the opposite direction. This air is heated by the cooling goods and gradually attains the maximum temperature of the kiln, thus ensuring the greatest efficiency of combustion. The goods on leaving the tunnel are almost cold.

The tunnel is built almost entirely of brick; low-grade fire bricks are used in the zones of low temperature, and silica or carborundum bricks in the high temperature zone. Suitable expansion joints are provided in the structure. The draught which supports combustion is provided by an exhaust fan.

Although the fuel-fired tunnel kiln is an improvement on the round kiln, it has certain drawbacks which can be eliminated by using the electric tunnel kiln. When the tunnel kiln is fuel-fired, the incoming ware is dependent for its preheating upon the outgoing combustion gases, which heat the upper portions of the ware more than the lower. This not only makes an even rate of preheating over a given cross-section practically impossible, but also limits the rate of preheating to the speed at which the coldest portion becomes sufficiently hot to advance into the high-temperature zone. In the case of an electric tunnel kiln, on the other hand, the absence of moving atmosphere makes an easier recuperation possible in a continuous operation by having two lines of the ware in the same or adjacent tunnels moving in opposite directions. Owing to the greater ease of control in temperature and atmosphere the electric kiln yields first-class ware of a uniformity which cannot be obtained in a fuel-fired kiln. In spite of these advantages the progress made in the use of electricity has been very slow on account of the high cost of electric power. In America especially the general opinion is that electricity cannot compete with such low-priced fuels as oil or natural gas. The use of electricity for heating at low temperature (up to 1,000° C.), for example, in decorating or enamelling kilns was introduced into Switzerland and Germany fifteen years ago.

After extensive research work and experimentation a number of electric tunnel kilns have been installed in Switzerland (since 1933) for the glazing of wall tiles, and for firing fireclay, soft porcelain and other goods requiring temperatures up to 1,300° C. The first kiln for firing hard porcelain was put into operation at the Langenthal Factory in Switzerland in August 1937 and was constructed by Messrs. Brown, Boveri. The main novelty of this kiln, apart from the high temperature of 1,400° C., is that part of the firing is conducted under a reducing oven atmosphere. Above 1,000° C. the heating must be done under reducing conditions, as otherwise the small amounts

of iron always present in the raw materials cause a yellowish-brown discoloration with a lowering of the transparency of the body mixture.

The Langenthal kiln is about 100 metres long with two tunnels, one for biscuit firing at 900° C. and the other for sharp firing at 1,400° C. The working experience of this kiln shows that apart from the smaller maintenance charges and high percentage of first-class ware obtainable, the savings in saggars is much more than the replacement charges on the elements. The writer concludes by saying that the success of the electric kilns can only be based on a proper combination of electrical engineering and ceramic knowledge.

VIBRATION OF PROPELLER BLADES

EARLY in 1936, at the instigation of the National Physical Laboratory, the Singing Propeller Committee of the Institution of Naval Architects included among other recommendations in its report a proposed research on "the manner in which typical blades vibrate and the effect on vibration characteristics of changes in shape, thickness, etc." Some two years later the research was approved by the Advisory Committee of the William Froude Laboratory.

One of the difficulties involved in the discussion of vibrating propellers has been the absence of any experimental knowledge of the modes of vibration of propeller blades. A few experiments were made by Mr. Harry Hunter, using a shaped flat plate of uniform thickness which was set in motion by 'bowing' it. This gave some patterns, but not frequencies. Tests with a single propeller blade having a flat driving surface have recently been published by Kerr, Shannon and Arnold. As before, the blade was held in a vice and vibrated by bowing the edge. Frequencies measured by tuning fork and mono-chord are given with their diagrams.

The method adopted to vibrate the blades in the present experiments was devised in conjunction with the Physics Department of the National Physical Laboratory, the apparatus being made and the experiments being carried out by E. J. Evans of that Department.

The model propellers were one foot in diameter, made with two blades on a heavy boss 2·25 in. in diameter and 3·2 in. in length. The blades were made flat on the driving face, which was in a horizontal plane when secured to the base plate by a 1·25 in. diameter bolt and nut. The propeller plates were made flat on the driving face, which was in a horizontal plane when secured to the base plate. The method of exciting vibration of the blades was by an electromagnet with its pole tips just above the blade surface. The pole tips were about $\frac{1}{8}$ in. square and $\frac{1}{8}$ in. apart, so that the exciting force was applied over a small area of the blade. The magnet could be moved horizontally over the whole surface of one blade. It was supplied with alternating current from a beat-tone oscillator and amplifier. The frequency could be varied continuously over a range of about 50–11,000 cycles per second. In addition to the alternating current, the magnet was supplied with direct current through a separate pair of coils. In this way the magnet produced an alternating field of known frequency superimposed on a direct field.

To find the resonant frequencies of the propeller, fine sand was sprinkled on the upper surface of the blades, and the exciting current was slowly varied through a given and known range of frequency. The resonance frequencies were detected by the loudness of the note emitted by the propeller, and by the sand on the blades taking a definite pattern, the sand usually moving towards the nodal regions. The magnet was moved about the blade in the tip region until the clearest diagram had been obtained on the blade under the magnet and the most intense note had been found. The frequency was then noted, the magnet removed, its position marked by a black dot, and a photograph of the sand pattern taken. A wide selection of these photographs are used to illustrate the paper.

Since the work was undertaken with a general idea of the results being applied to the problem of the singing propeller, it was desirable to know the range of frequencies which need to be studied for this purpose. The noise (if any) made by a bronze propeller about 18 ft. in diameter, propelling a ship in smooth water, is either a low-pitched hum with beats in it proportional to the number of blades and a frequency varying from 200 cycles per second to a somewhat higher figure; or a grinding noise or grunt with a maximum once per revolution of propeller, the major tone of which may vary from 200 to 300 c.p.s. Either or both of these may be present.

There are two principal modes of vibration which need to be considered, namely, (1) that in which the blade tip as a whole moves perpendicularly to the blade surface, which is referred to as flexural, and (2) that in which the blade twists from the boss about a more or less central line lying on its surface, referred to as torsional. Formulæ for a blade of parabolic outline, obtained by Conn, are given for these two kinds of vibration.

Although the two blades of any propeller were made alike within the normal limits of error for model work, it was found that actually they had slightly different resonant periods. The extreme figures obtained for the two blades for any mode of vibration are given. . It is concluded that some of the variations must arise from variations in the metal of the two blades. Torsional and mixed resonance are also discussed and tables of extreme values of cycles per second are given.

A broad comparison of the results obtained with those given by others indicates that most of the patterns obtained by H. Hunter are at too high a frequency to have much bearing on the singing propeller problem. The patterns shown in the paper by Kerr, Shannon and Arnold present some difficulties when compared with those in this paper. Possibly the difference arises from the fact that in these tests the exciting force was continuous and not a single strong burst of vibration. Twenty-five vibration patterns of propeller blades are shown.

HEAT INSULATION IN ELECTRIC POWER STATIONS

HEAT insulation of pipes, boilers and generating sets, which used to be indicated by the general term 'lagging', has now become an art in itself and, to obtain the best results, the material must be graded and applied in a totally different manner for high-, medium- and low-temperature pipe lines and surfaces. In a paper presented at a semi-annual meeting in Milwaukee to the American Society of Mechanical Engineers by Messrs. E. T. Cope and W. F. Kinney, engineers to the Detroit Edison Co., the authors point out that in water-cooled boiler furnaces used in steam generating plants, it is common experience to find that cracks develop in the insulation on water-cooled furnace walls as the result of: (*a*) expansion and contraction of the setting, (*b*) shrinkage of the material, (*c*) settling of the material or (*d*) loosening of the material due to faulty attachment. Because of the likelihood of air infiltration as a result of this situation and to provide a pleasing external appearance, it is frequently considered necessary to encase waterwall furnaces in airtight steel shells, which in turn may require insulation.

Experience has shown that it is virtually impossible to maintain airtight any of the assemblies used in practice unless all-welded steel casings are used, but this is an elaborate and expensive construction and no satisfactory economical method has yet been found. Large areas comprising air-ducts, breechings, fan-housings, tanks and similar equipment are subject to vibration and considerable expansion and contraction. The presence of hot gases varying from perhaps 100° to 600° F. on the inside of the wall with insulation on the exterior is conducive to a great deal of warping and irregular movement, which in turn affects the tightness of the insulation. To provide for this movement, expansion joints are usually installed in various locations on the equipment. It is difficult to retain blocks, blankets, or insulating cement on a surface where so much relative movement and vibration takes place. Unless extreme precautions are taken during the installation, loosening of the insulation will be a recurring problem.

Large pipe-bends are still covered with double-layer block insulation, leaving an expansion joint covered with curly glass wool at both ends of each bend.

The selection of thermal insulation for steam turbines is a problem that presented few difficulties in the past, when the operating steam temperatures were well within the temperature limit for asbestos and magnesia products. In recent years the design of steam-generating equipment and turbines has advanced so rapidly in the direction of higher steam temperatures that severe operating conditions are imposed on insulating materials.

Plastic insulating cement has grown in favour because it permits easy application over the irregularities in the turbine shell, but it must be applied in layers, preferably less than 2 in. thick, covered with reinforcing netting secured to lugs on the casing, and trowelled with a finishing cement—a procedure which requires several days to permit adequate drying of each layer on a cold surface. It is questionable whether admitting steam to the turbine to expedite drying of the plastic insulation is an acceptable operating practice, due to the possibility of inducing unequal stresses in the bolts, flanges and appendages.

The advantages of flexibility and low thermal co[n]ductivity of reinforced open-face flexible insulati[n]g blankets are offset by the widespread objection [t]o having around the turbine a loose wool that ma[y] become detached from its backing, and to the diff[i]culty of cutting the metal mesh reinforcement to fi[t].

Finally the following conclusions, among other[s] are reached: (*a*) Insulating pads, composed of [a] textile jacket enclosing a loose filler, appear to be th[e] most desirable form of insulation for turbines. (*b*) A[s] determined by extensive field tests, there is on[e] brand of glass fabric pad with glass-wool filler that [is] preferred for temperatures up to 1,050° F., and tw[o] brands of reinforced white asbestos pads with eith[er] mineral-wool or amosite asbestos fibre filler are co[n]sidered reasonably acceptable. (*c*) From actu[al] installations on various sized turbines operating [at] different steam temperatures from 700° to 910° F[.] it was concluded that 50° F. appears to be a reaso[n]able temperature difference between the outsid[e] surface of the insulation and the ambient air.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER TO TAKE ENGINEERING WORKSHOP PRACTI[CE] AND ALLIED SUBJECTS in the Willesden Technical College—Dr. Davies, Education Offices, Dyne Road, Kilburn, London, N.W (January 15).

LECTURER IN MECHANICAL ENGINEERING—The Registrar, Wimbl[e]don Technical College, Gladstone Road, London, S.W.19.

PRIMARY EDUCATION OFFICER (MALE) for the Education Depa[rt]ment of the Government of Kenya—The Crown Agents for t[he] Colonies, 4 Millbank, London, S.W.1 (quoting M/9531).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health: Ministry of Home Security. Recommendati[ons] of Lord Horder's Committee regarding the Conditions in Air-Ra[id] Shelters, with Special Reference to Health; and a Brief Stateme[nt] of Action taken by the Government Thereon. (Cmd. 6234.) Pp. (London: H.M. Stationery Office.) 2*d.* net. [21

Freshwater Biological Association of the British Empire. Scient[ific] Publication No. 3: The Food of Coarse Fish; being the Inter[im] Report on the Coarse Fish Investigation. By P. H. T. Hartley. [Pp.] 33. (Ambleside: Freshwater Biological Association.) 1*s.* 6*d.* [26

The British Academy. Presidential Address, 10 July 1940. Sir David Ross. (From the *Proceedings* of the British Academy, V[ol.] 26). Pp. 8. (London: Oxford University Press.) 6*d.* net. [2

Other Countries

Commonwealth of Australia: Council for Scientific and Industr[ial] Research. Fisheries Circular No. 1: Some Notes on the Smok[ing] of Fish. By E. J. Ferguson Wood. Pp. 6. (Melbourne: Gove[rn]ment Printer.) [2

Bulletin of the American Museum of Natural History. Vol. Art. 6: The Spiders of Texas, I. By W. J. Gertsch and S. Mulaik. [Pp.] 307–340. (New York: American Museum of Natural History.) [27

Annual Report on the Forest Administration of Nigeria for [the] Year 1939. Pp. 37. (Lagos: Government Printer; London: Cro[wn] Agents for the Colonies.) 1*s.* 6*d.* [27

The Cooper Union for the Advancement of Science and Art. Eigh[ty-]first Annual Report, July 1, 1940. Pp. iii+141. (New York: T[he] Cooper Union for the Advancement of Science and Art.) [2

U.S. Department of the Interior: Office of Education. Vocatio[nal] Division Bulletin No. 204 (Occupational Information and Guida[nce] Series No. 1): Occupational Information and Guidance; Organi[za]tion and Administration. With a Brief Survey of the Development [of] Guidance and Reports on Present Practices. By Layton S. Hawki[ns,] Harry A. Jager and Giles M. Ruch. Pp. vii+181. (Washington, D.C.: Government Printing Office.) 25 cents. [2

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 19, 19[..] vii. Meteorologiska iakttagelser i Riksgränsen. Pp. 44. 4.00 Årsbok, 21, 1939. ii. Nederbörden i Sverige. Pp. 15+1 plate. 2.50 Meddelanden, No. 32: The Lag-Coefficient of Aerological Instrume[nts] and the Function of Hair Hygrometers at Low Temperatures. By Nyberg. Pp. 20. Meddelanden, Band 7, No. 7: Vårflödet i Norrländs vattendrag samt i Dalälven och Klarälven. Av Folke Bergsten. [Pp.] 14. 1.50 kr. (Stockholm: P. A. Norstedt and Söner.) [2

Issue Date	Issue Date	Issue Date
497		11-11-